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ShopNotes

Vol. 14 Issue 84

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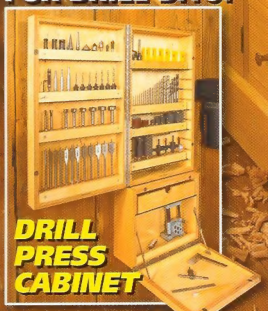

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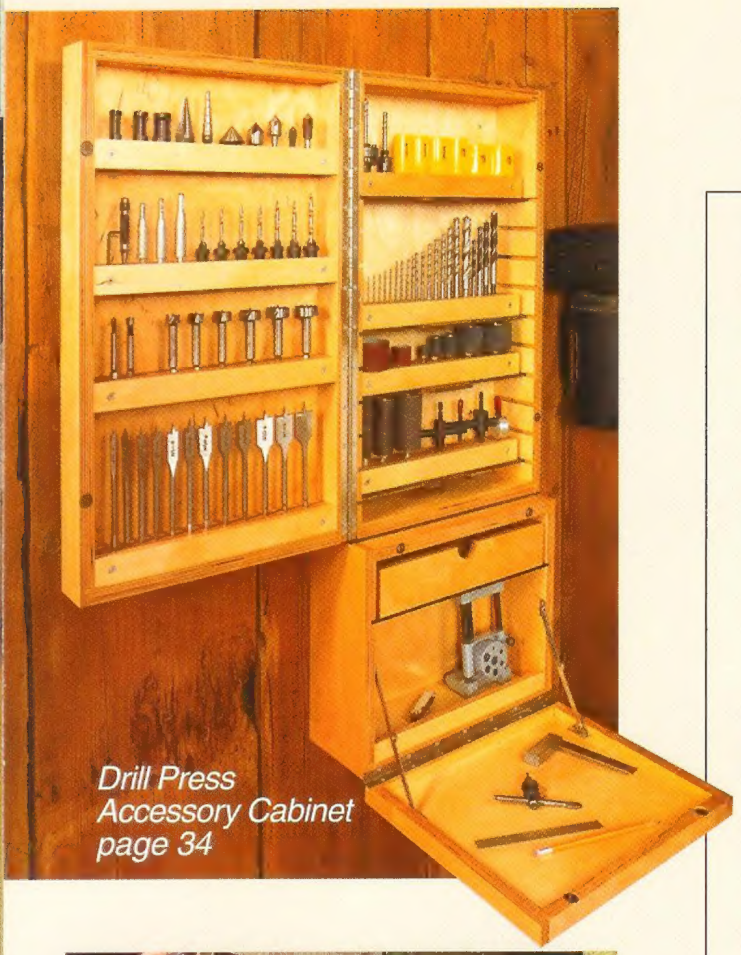

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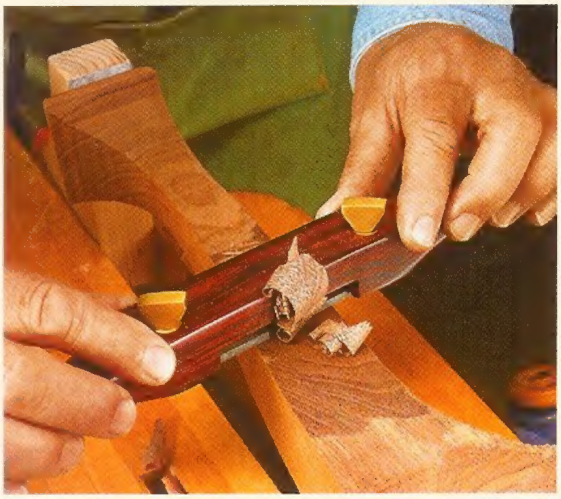
Shop Short Cuts *page 14*



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Cutoffs

Several years ago, I was down in my shop cleaning some rust off an old hand plane. As I went along, I tossed the used pieces of steel wool into a pile on the end of my bench. Suddenly, as if by magic, the pile of steel wool burst into a ball of fire.

The "magic" turned out to be a seemingly harmless, cordless drill battery lying on the bench. Some of the steel wool had touched the battery contacts. The electric charge instantly ignited the steel wool like tinder. Fortunately, after a moment of stunned shock, I was able to smother the smoldering steel wool before anything else caught on fire.

The next morning, I went out and purchased what's now the most important tool in my shop — a fire extinguisher. To find out more, check out the article that begins on page 42.

Terry

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This symbol lets you know there's more information available online at **www.ShopNotes.com**

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Tips for Your Shop

Hand Plane Storage Rack

Storing hand planes has always been a challenge in my shop. Since most planes are long, they don't fit well on a shelf. And when stored in a drawer they're not always easy to reach when I need one.

To keep my planes organized and accessible, I built the simple storage rack you see in the photo. It hangs on the wall so it's out of the way. And the planes are in sight and easy to find when needed.

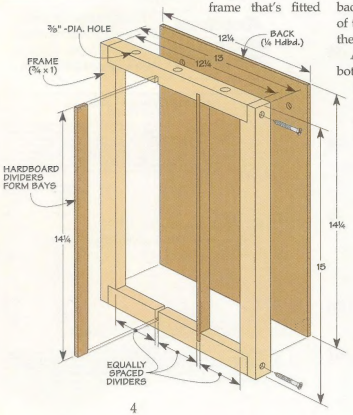
The rack is simply a hardwood frame that's fitted with a ¼" hardboard back. The back fits into rabbets cut in the back of the frame and is used to mount the rack to the wall.

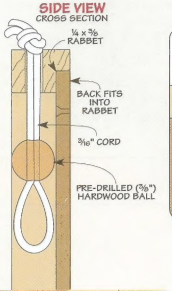
A couple of slots at the top and bottom hold hardboard dividers (detail 'a'). These dividers form bays that separate the planes and keep them from bumping into one another.

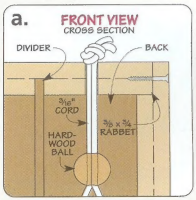
To hold the planes in the rack, I drilled a hole at the top of each bay, passed the ends of 3/16"-dia. nylon cord through the hole, and secured them with a knot. A pre-drilled hardwood ball slips over the cord to adjust the loop around the knob.

Now plane storage is easy. Just set the plane in the rack and tighten the cord securely around the knob.

David Myer
Lakeland, Florida







Free Tips
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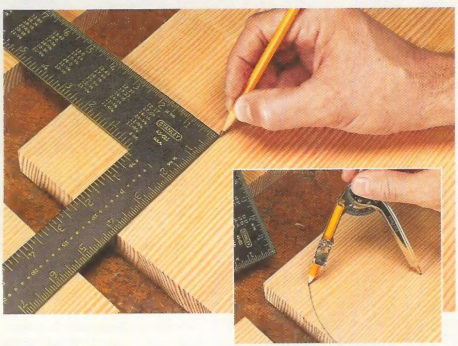
Finding a Corner Radius

I often need to make a nice, rounded corner on a workpiece. But this can often lead to a lot of trial and error until I get the corner radius just right.

You'll find a carpenter's square and a compass makes this task quick and easy. And the results are perfect every time.

For example, I needed a 4" radius at the corner. So I lined up the edge and end of the workpiece with the 4" mark on the outside of both legs of the square (see photo below). Then mark the point of the square. Finally, put the pointed arm of the compass on this mark, extend the compass to the edge of the workpiece, and scribe the line.

Craig Kelley
Knoxville, Iowa



Win A Porter-Cable Router

That's right, send us your shop tips. If your tip or technique is selected as the featured reader's tip, you'll win a Porter-Cable router just like the one shown below. Just write down your tip and mail it to: *ShopNotes,* Tips for Your Shop, 2200 Grand Avenue, Des Moines, Iowa 50312. Please include your name, address, and daytime phone number (in case we have any questions). If you would like, FAX it to us at 515-282-6741 or send us an email message at: shopnotes@shopnotes.com. We will pay up to $200 if we publish your tip.

The Winner!

Congratulations to *Frank Penicka* of *Mount Pearl, Canada.* His tip on *making a jig for cutting relief grooves in dowels* was selected as winner of the Porter-Cable router just like the one shown at right. The jig makes a quick and easy job of adding glue relief grooves to dowels.

To find out how you could win a Porter-Cable router, check out the information above. Your tip just might be a winner.

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Grooving Jig for Dowels

I make my own dowels and like to have relief grooves cut in them to allow space for excess glue. So I built a handy jig that makes quick work of adding grooves. It's simple to build and easy to use.

The jig has two parts, a handle and a block beneath that holds a pair of cutting blades (see drawing below). The handle has a hole that's sized to fit the dowel.

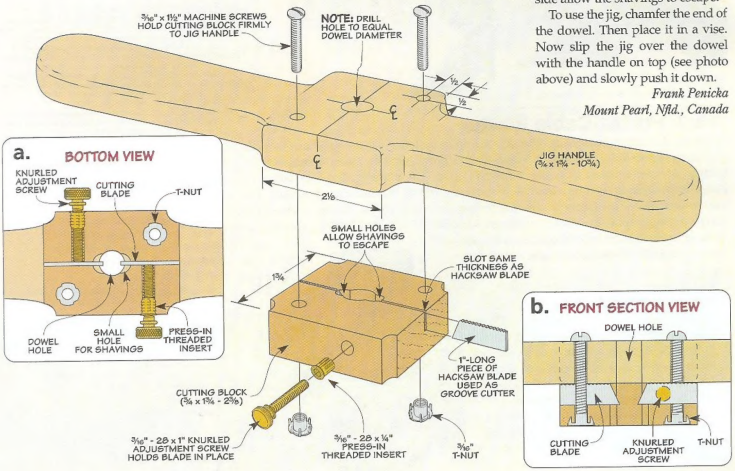
The small cutting block is attached below the handle by screws and T-nuts. A slot cut partially through the thickness of the block holds two sharpened pieces of hacksaw blade. It's important that you cut the slots the same width as the hacksaw blade so the blades fit tightly in the slot.

A hole drilled to the depth of the slot on each side of the block receives a press-in threaded insert and a knurled screw. These screws are tightened to hold the cutting blades securely in position.

Once the handle is attached to the block, you can drill a hole through the cutting block. Be sure to drill this hole from the handle side so the two holes are perfectly aligned. Two small holes on each side allow the shavings to escape.

To use the jig, chamfer the end of the dowel. Then place it in a vise. Now slip the jig over the dowel with the handle on top (see photo above) and slowly push it down.

Frank Penicka
Mount Pearl, Nfld., Canada



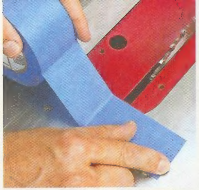
Miter Gauge Alignment Mark

Whenever I need to cut a number of pieces using the miter gauge on my table saw, I find that I often spend quite a bit of time between cuts aligning the blade with my cut marks. So to speed up the process and still make accurate cuts, I applied a mark to my saw table to help me quickly line up these cuts.

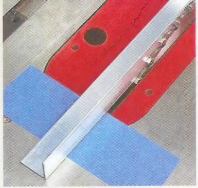
I didn't want a permanent mark on the table of my saw, so I used a piece of blue painter's tape as my marker. The tape is easy to see and can be quickly removed without leaving sticky residue behind.

First, I laid a strip of tape about 2" in front of the blade. I wanted the edge of the tape aligned with the teeth of the blade, so I used a long piece of aluminum angle to butt up against several of the teeth. Next, cut along the straightedge and remove the left side of the tape. Then just align the mark on the workpiece with the left edge of the tape and make the cut.

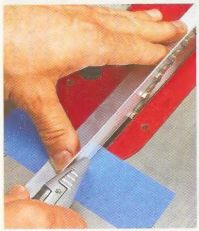
Len Urban
Rancho Mirage, California



▲ *Apply the Tape.* First, apply a piece of painter's tape to the top of the saw table a few inches in front of the blade of the saw.



▲ *Choose A Straightedge.* The straightedge should have enough height and length to butt up against several teeth on the saw blade.



▲ *Trim Along the Straightedge.* Line up the straightedge with the blade, cut a line through the tape, and remove the piece on the left.

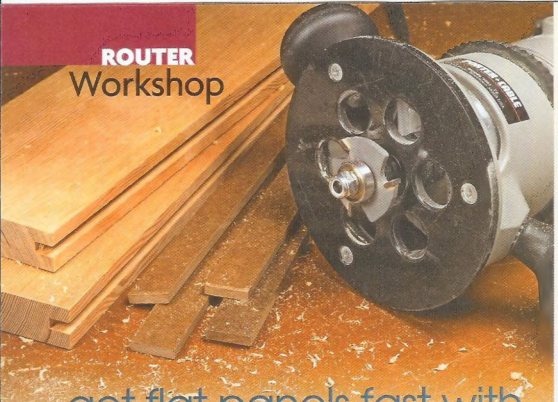
▲ *Line Up the Cut.* To make a quick and accurate cut, you can simply line up the workpiece with the left edge of the tape.

Quick Tips

▲ *Michael Gerdes of New Bern, NC places old belts around the jaws of his machinist vise to protect the piece he's working on. He cuts the belts to fit around the jaws and then punches new notches in each belt.*

▲ *To keep debris off of his band saw tires, Chad Husting of Mason, OH cuts off the head of a toothbrush and glues it to a stack of magnets so that it rubs against the tire.*

A vacuum extension mounted ► *to the wall lets Mike Oslund of San Antonio, TX get rid of his dust pan. He just sweeps dust to the nozzle.*



get flat panels fast with Splines

This simple hand-held router technique will give you smoother panels in less time.

Edge gluing panels — sounds easy enough. Take a few boards, apply glue to the edges, and clamp them together to make a wide panel.

For small panels, there's not much more to it. But the challenge comes when gluing up larger panels like the workbench top on page 16. As the boards get longer, they aren't likely to be perfectly flat. The result can be joint lines that aren't flush. Working these joints flat can be time consuming. To avoid the problem, I turn to a simple, router technique.

ROUT SLOTS FOR SPLINES

To create a flat panel, I rout narrow grooves in the edges of the boards. Then I fit splines in the grooves to coax the boards into alignment. The splines act like a key to lock the boards in place. The trick is routing the slots the "right way."

I like to use a hand-held router. Here's why: the small base of the router follows the "hills and valleys" of the workpiece (drawing below). The result is a slot that's parallel to the surface and consistent from board to board.

I rout the grooves working from the top face. This means the top of the panel will be aligned for sure. And any slight variation in board thickness will be on the unseen, bottom face of the panel.

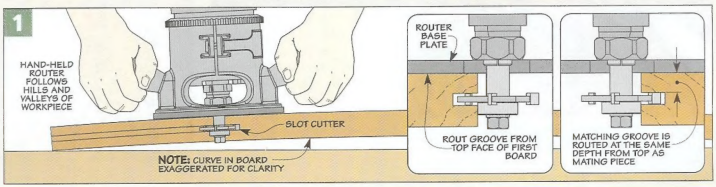
Slot-Cutting Bit. Making a slot requires a slot-cutting bit. It looks like a mini saw blade, as shown in the photo on the opposite page.

There are two styles available. The most-familiar type has two, three, or four teeth on a cutterhead. To change the size and depth of the slot, you can buy additional cutters and bearings.

The other type of slot cutter is designed more like a stack dado set for a table saw. Instead of just one cutterhead, it comes with several, each cutting a different width slot. What sets this bit apart is the cutterheads can be stacked on an extra-long arbor to create custom-sized grooves. You'll also find a range of spacers and shims to fine-tune the slot width. Some sets even come with multiple bearings so you can change the slot depth.

If possible, select a slot cutter with a ½" shank. This beefier bit is less likely to deflect during the cut and will give you smoother results.

Sizing Splines. As for the size of the splines, I like to use 1"-wide splines for large panels like the benchtop shown above. That means routing a ½"-deep groove in



each piece. For smaller panels, you can use ½"-wide splines.

Spline Material. Once you have the bit taken care of, the next order of business is to choose a spline material. And here you have a lot of choices from hardwood to hardboard or plywood.

The problem with hardwood is that a long grain spline can split along the joint line while you are trying to get the parts lined up, which defeats the purpose. For my money, ¼" hardboard works best. It has a strong, uniform consistency, which keeps it from splintering. It comes in large sheets that are great for cutting long splines. And hardboard is pretty inexpensive.

Loose Splines. Now I know that ¼" hardboard can be slightly less than ¼" thick. But I haven't found that to have much effect on the performance of the spline.

But if you want a really snug fit for the splines, there are two things you can do. One way is to start with a thinner slot cutter (3/16" for example) and just make two passes. The only trouble with this is the time-consuming extra step.

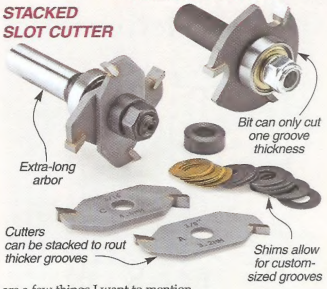
The second solution, is to use a stacking slot cutter and assemble the cutter stack so it perfectly matches the spline thickness.

Cutting the Splines. The next step after you have routed slots in all the edges, is to rip some spline stock to width. When doing this, I like to cut the splines slightly narrower than the slot depth, as you can see in the right detail drawing. This provides room for excess glue and guarantees that the boards will come together without a gap.

Gluing the Panel. Assembling a panel with splines isn't much different than edge gluing. But there are a few things I want to mention. First, I apply glue to the edges of the boards *and* to the grooves. Second, you may need to apply some gentle pressure to the misaligned sections of the panel to get the splines to pop into the grooves.

After you take the clamps off, the results will be obvious. The surface of the panel will be pretty flat and you'll spend less time in a cloud of dust sanding joints flush.

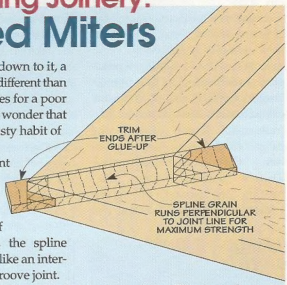
You may even find that you can use splines to solve other woodworking problems. You can read about another way to put splines to work in the box at left.



Reinforcing Joinery:
Splined Miters

When it comes right down to it, a miter joint isn't much different than a butt joint. This makes for a poor glue surface. So it's no wonder that miter joints have a nasty habit of failing over time.

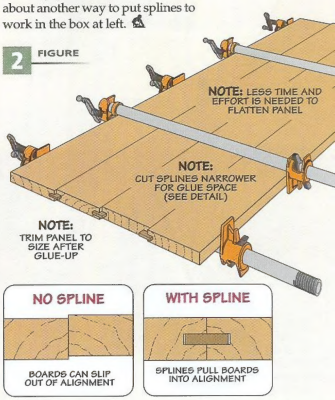
To keep the joint from opening, I like to use splines to add strength to the joint. Now, instead of a simple butt joint, the spline makes the joint more like an interlocking tongue and groove joint.



Router Table. Unlike adding splines to glued-up panels, this is a task for the router table. With smaller workpieces, you'll have more control by using the fence.

Cross-Grain Splines. There are a few other things to think about when adding splines to miter joints. The first is the type of spline to use. Here, I usually use a hardwood spline. But I make sure the grain runs across the joint line, as you can see in the drawing above. This way, the spline is less likely to split and will expand and contract along with the frame pieces.

Visible or Invisible. A second thing to consider is whether you want the spline to be visible on the corner of the joint. If so, you may want to use a spline with a contrasting color to add a decorative touch. But if you don't want to see the spline, rout a stopped slot on each workpiece.



shop cabinet Levelers

Keep your shop on an even keel with a set of heavy-duty levelers.

Nothing is more frustrating than to set up a shop cabinet and have it rock and wobble because your shop floor isn't level. The solution for this all-too-common problem is to install levelers.

Advantages. Besides leveling your shop cabinets, there are other advantages to adding levelers. Keeping your cabinets off the floor protects them from absorbing moisture through the floor or from any spills. That's especially true if your cabinets are made from particleboard or MDF, because they can soak up moisture and swell.

Another benefit of using levelers comes when moving the cabinets around. Levelers not only make the cabinets slide easier, but they also protect the bottom edges of the cabinet from the chipping or splintering that moving may cause. There's nothing worse than hearing the sound of veneer peeling off plywood because you had to nudge your cabinet just a little closer to the wall.

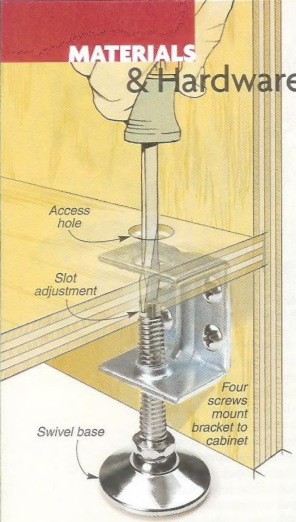
Heavy-Duty. As you can see here, levelers come in a variety of shapes and sizes. But what you don't see are the lightweight plastic kind. They're just not strong enough for shop use. In my shop, I use the sturdy, all-metal levelers that you buy at woodworking specialty stores. (Sources on page 51.)

A leveler isn't all that complex — it's essentially a pad attached to a threaded rod. The rod passes through a metal bracket attached to the cabinet. There are two advantages to this design. One is added strength. The other is the brackets and pads can be ordered separately, allowing you to customize them for your specific needs.

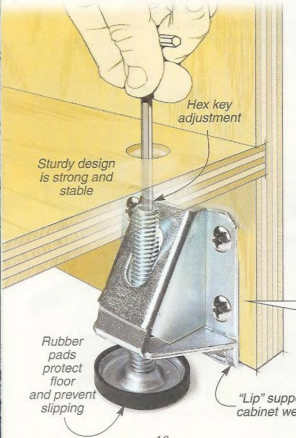
Adjustment. You can adjust the height of levelers in different ways. For example, some levelers are adjusted by simply twisting the pad or an adjusting nut. Others are adjusted by using a screwdriver (top left photo) or a hex key (bottom left corner photo) on top of the threaded rod. Most of the time, you'll have to adjust these types of levelers through a hole drilled in the bottom of your cabinet.

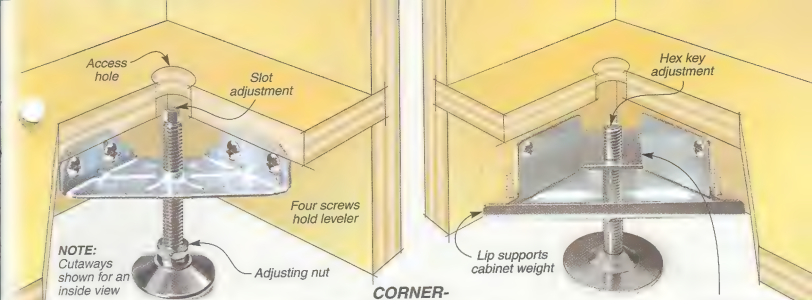
SIDE-MOUNT

Levelers come in either side-mount and corner-mount. Two types of side-mounted levelers are shown on the left. They can be mounted to either the inside or the outside of the cabinet. But if you mount them to the inside of the cabinet, you'll have to drill an access hole in the



SIDE-MOUNTED LEVELERS





CORNER-MOUNTED LEVELERS

bottom shelf to be able to adjust them, or to allow room for the threaded rod to come through.

The "U" bracket on the opposite page is the simplest to install. All it takes is four screws. But while it's the easiest to install, it's also the weakest. The weight of the cabinet is carried by those four screws, which are often less than ¾" long. And screws that short don't have a lot of holding power, especially in particleboard and MDF.

If you want a side-mounted leveler that will handle a heavier load, step up to one with a "lipped" bracket. Instead of relying on only four screws for strength, the sides of the cabinet are supported by a flange that goes underneath the bottom edge. This leveler also adds stability with its beefed-up design.

CORNER-MOUNT

The levelers that work best for me are the corner-mount models you see above. Even though they mount underneath the cabinets — making them a little harder to adjust — that inconvenience is offset by the added strength and stability they provide. These levelers can hold more weight because they attach to two sides of the cabinet. And, like the side-mounted levelers, they use four screws and come in a "lipped" variety too.

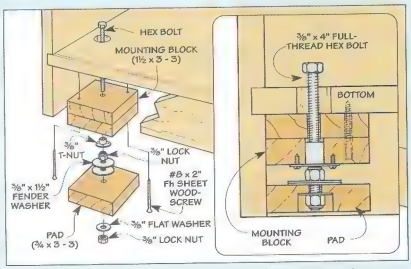
So for me, there's no skimping when it comes to levelers for my shop cabinets. For your shop, make sure to get heavy-duty levelers like these that can take some punishment and still provide a firm foundation and good protection for your shop cabinets.

Shop-Built: Leveler

With just a handful of hardware and some scrap blocks, you can quickly make your own levelers.

Basically, each leveler consists of two parts: an adjustable pad and a thick mounting block that attaches to the bottom of the base. By turning a bolt that passes through the center of each piece, you can raise or lower the pad.

Mounting Block. To provide plenty of strength, each mounting block is made by gluing up two pieces of ¾"-thick hardwood. Before gluing and screwing the mounting block to the bottom of the base, you'll need to drill a counterbored shank hole to hold a T-nut that accepts the adjustment bolt.



Pad. Once the block is in place, you can add the pad. It's also a piece of ¾"-thick hardwood that's captured on the end of the bolt by a pair of lock nuts.

One of the nuts rests in a counterbored shank hole drilled in the bottom of the foot. The other tightens against the top of the foot to lock it in place.

▲ *Easy Adjustment. To raise or lower this shop-made leveler, simply turn the adjustment bolt with a socket wrench.*

easy-to-use Toggle Clamps

Reach for these clamps for the ultimate in versatility and safety in your shop.

Part of the enjoyment I get out of woodworking is finding ways to work smarter and safer. So if I find myself needing an extra pair of hands, I'll often turn to toggle clamps. They help me concentrate on the job at hand.

Toggle clamps make your work safer by keeping parts in place without slipping. You get better control of the workpiece, especially small or hard-to-hold parts.

Their uses in the shop are unlimited. For example, I use them to make clamping jigs for gluing up projects. And they make excellent hold-down fixtures for routing, drilling, or sawing.

I also like toggle clamps because they're easy to use. With just a quick flip, I can snap the handle into the clamping position. Releasing them is just as easy. All it takes is a gentle tug on the handle with a couple of fingers. They really do "toggle" the clamping pressure on or off.

When you first look at these clamps, it's hard to understand how they work. But after experimenting with them, you see what makes them so powerful.

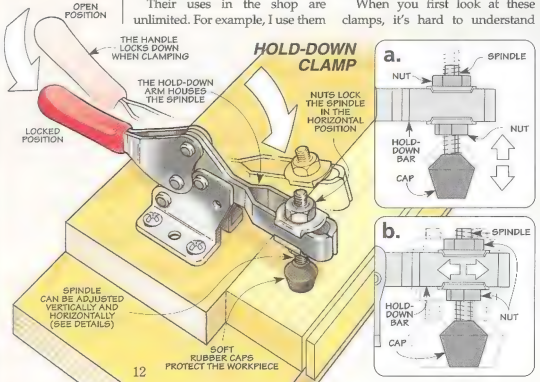
It's really physics at work. The handle acts as a lever that transfers all the force you apply into a single point and then locks it down. It's an ingenious design. It doesn't take much effort to put a lot of clamping pressure on your workpiece.

Two types of toggle clamps that I find most useful are the hold-down and straight line types.

HOLD-DOWN CLAMPS

Hold-down clamps apply clamping pressure vertically. They're great for making a ripping jig (main photo above) or miter sled for your table saw. They also come in handy at the drill press. You can use them to hold small parts in position so your fingers don't have to be close to a spinning drill bit, as shown in the inset photo above.

Adjustability. What I like most about these clamps is how easy they are to adjust. With the hold-down style of clamp, you can adjust the spindle both vertically and horizontally. Simply adjust the height of the threaded spindle by loosening the top and bottom nuts and turning the spindle to change



the height. Detail 'a' on the opposite page shows how it works. This controls the amount of pressure applied when you push the lever down to the clamping position. It also lets you adjust for different workpiece thicknesses.

You'll also notice that the hold-down arm is slotted to accommodate horizontal movement of the spindle. This allows you to slide the spindle along the arm to fine-tune where the pressure is applied. Detail 'b' on the opposite page shows this adjustment.

STRAIGHT LINE CLAMPS

Straight line clamps are a little different than hold-down clamps. They work by applying pressure horizontally. This makes them ideal for use in jigs for gluing up projects, as in the main photo above. I'll also use a straight line clamp on my drill press to hold a workpiece against a fence, like you see in the inset photo at right.

On a straight line clamp, the plunger moves in or out horizontally, similar to a piston. This design only allows horizontal adjustment for the spindle. You loosen the jam nut and turn the threaded spindle in or out to change the clamping pressure (drawing below).

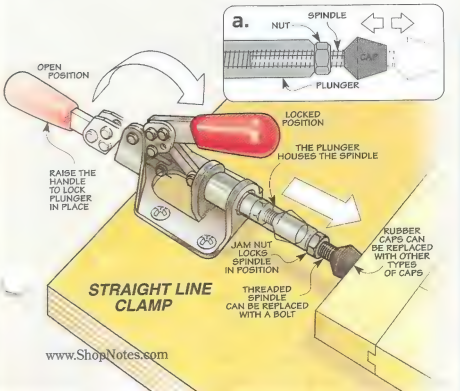
CUSTOMIZED PRESSURE

With both types of toggle clamps, you can customize the amount and type of pressure you apply. They come with rubber caps, as shown in the drawings. But you can also order other types of caps.

For more versatility, you can replace the spindle with a standard hex bolt, as illustrated in the main photo above. This lets you apply more pressure in a concentrated area than you might get using just the soft rubber caps.

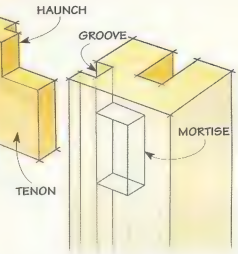
Other Choices. One of the downsides to the metal toggle clamps shown here is that they can be a little pricey. I've found that plastic versions cost less and work very well. And because they're plastic, they aren't as likely to harm your tools if they happen to encounter a sharp cutting edge. You can read more about these in the box below. For sources for the metal and plastic toggle clamps, see page 51.

Once you start using toggle clamps, you'll find all sorts of handy uses for them in your workshop. They make your time spent in the shop a lot more productive with better results — and they're a whole lot safer.



Plastic Toggle Clamps

Economical Alternatives. Plastic toggle clamps are suprisingly strong. For occasional clamping needs, or if you're just wanting to give toggle clamps a try in your shop, these are good choices.



Shop Short Cuts

Handling a Haunched Tenon

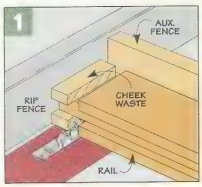
Mortise and tenons are a solid way to join frame and panel assemblies like the ones used on the workbench on page 16. But what makes the tenons used here a little different is the small "haunch" at the top of the tenon (drawing above).

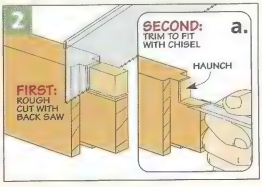
Why a Haunch? Instead of cutting all the shoulders of the tenon so they're flush with each other, it's important to leave the "top" shoulder extended a bit. This way, the haunch fills the end of the groove cut earlier in the legs.

Creating the haunch isn't difficult. Start by cutting the cheeks of the tenon to fit the mortise. This is just a matter of trimming each side of the rails and stretchers (Figure 1) until the tenon just slips into the groove. (It's the same width as the mortise.)

Trim to Fit. Once the cheeks are cut, you're ready to trim the tenon so the shoulders butt tight against the legs and the haunch fits tight against the bottom of the groove.

I found it easiest to do this by rough-cutting the tenon to size with a back saw first, as illustrated in Figure 2. Then it's just a matter of trimming the tenon and shoulder with a chisel (Figure 2a) until you have a nice, tight fit.





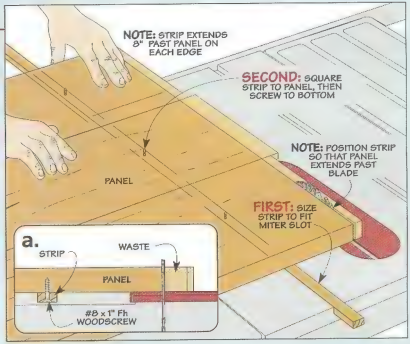
Squaring a Large Panel

Using the table saw to square up the ends of a large glued-up panel (like the benchtop on page 16) is a challenge. The panel is too wide to cut safely or accurately with a miter gauge or sled. The solution is to use a wood strip to guide the panel through the saw (see drawing).

Make the Strip. For this to work, the strip should fit the miter slot snugly, but still slide smoothly. And for best results, the strip should be long enough to extend 8" past each edge of the panel.

Attach the Strip. Once you have a good fit, you're ready to attach the strip. And there are a couple things to keep in mind here. First, the strip needs to be located so the end of the panel extends slightly past the blade, as in detail 'a.' Second, the strip needs to be square to the edge of the panel. (I used a framing square.)

Make the Cut. Depending on the size of your saw's extension table to the right, you may need to provide extra support for the panel as you make the cut. So set up extra outfeed and side supports before you start.



Routing Square Holes

The workbench on page 16 features traditional, square bench dogs. And for that you need square "holes." To make quick work of completing these holes, I turned to my hand-held router, a ½"-dia. pattern bit, and a handy shop-made jig.

Making the Jig. Since a pattern bit will follow the edges of a template exactly, the key to accurately routing the dog holes is taking the time to make the jig just right.

You can find all the information you'll need to build the jig in the Dog Hole Jig drawing shown at right. On the top of the jig, you'll see a pair of openings created by three shaped patterns. The patterns are attached to a pair of glued-up cleats that butt tight against the edges of the bench dog strip. The guide strips keep the jig in just the right position as it's screwed in place, like you see in Figure 1.

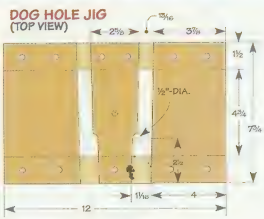
Two Openings. Each opening is shaped like a bench dog and the openings are angled toward each other. As shown in Figure 1, one opening is used to rout the holes in the bench dog strip. The other opening is then used to rout the holes in the tail vise strip (Figure 2).

Since the bench dog holes you rout will match the jig exactly, be sure to test fit the bench dogs in the jig and then make any adjustments before you start routing your workpieces.

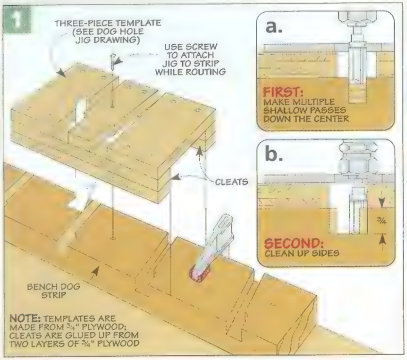
Routing the Holes. Once the jig is complete, routing a dog hole is just a matter of laying out their locations and screwing the jig over the workpiece so the opening lines up with the layout, as in Figure 1. Don't worry about the screw holes, they'll be covered up when you attach the strips to the bench.

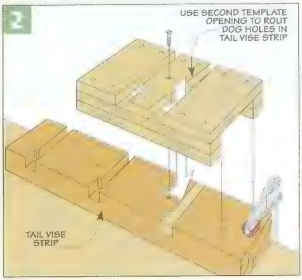
Since you'll be routing the dog holes across the grain, you don't want to remove all the waste in a single pass. I found that a series of shallow passes works best (no more than ¼" deep). But there's one small problem. For the first couple passes, the bearing won't make contact with the edges of the jig.

To solve this problem, you'll need to carefully rout down the *center* of the opening to remove most of the waste, as in Figure 1a.



Once the bearing is below the top of the jig, you can then trim along the edges to remove the rest of the waste, like you see in Figure 1b. Note: Be sure to set the depth stop on your router at the final depth of cut (¾"). This way, each dog hole will end up identical.





This workbench has it all — classic looks, plenty of storage, plus a top and vises able to handle the most demanding tasks.

classic cabinet-base Workbench

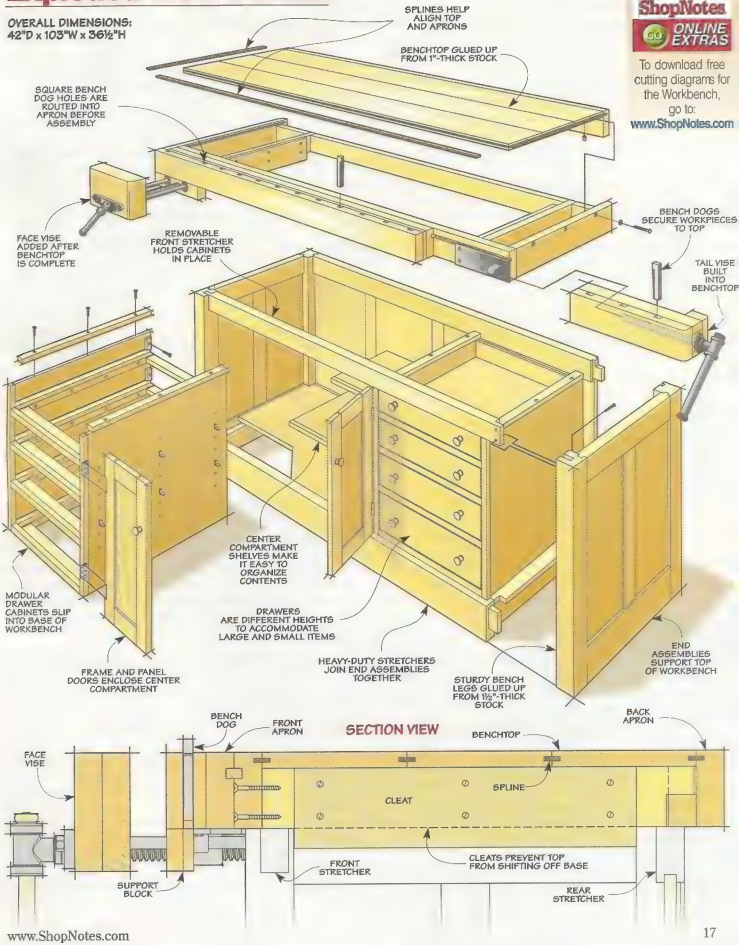
Just about every woodworker I know would like to build a workbench like the one shown above. But a lot of them might be a little intimidated about building what looks like a complicated project. But you don't have to worry — this design features simple solutions that make building the bench manageable.

For starters, the workbench consists of a number of easy-to-build components that join together to form a solid foundation. As for the cabinets and drawers, they simply slip into place. Since they don't provide any support for the top, you can add them at any time. Speaking of the top, it's not a mass of strips that can be hard to glue up and then flatten. Instead, the top is just a few thick boards wrapped with a wide apron.

Finally, adding a pair of traditional vises along with square bench dog holes doesn't have to be a challenge. There's a handy jig to help with the dog holes and step-by-step instructions make installing the vises a snap.

Exploded View Details

OVERALL DIMENSIONS:
42"D x 103"W x 36½"H



ShopNotes ONLINE EXTRAS

To download free cutting diagrams for the Workbench, go to: www.ShopNotes.com

building the Base

When it comes to building a workbench, the base has to do two things. It needs to be strong and stable.

To meet these requirements, I started with heavy-duty legs and joined them with beefy rails to create a pair of end frames. Then, the frames are connected by long stretchers. To enclose the base, stiles and solid wood panels are added to the end frames and back.

Start with the Legs. The first step is to make the legs (Figure 1). I did this by gluing up two pieces of 1½"-thick stock. To avoid the problem of keeping the pieces aligned as I glued them together, I started with extra-wide pieces. Then, after squaring up each blank and ripping it to final width, you can cut the legs to length.

Mortises & Grooves. To join the rails of each end frame to the legs, I used large mortise and tenon joints. But before making the mortises, I cut grooves in the legs to hold the solid wood panels and stiles that are added later. Cutting the grooves first allows you to use them as a guide for the mortises (see box below).

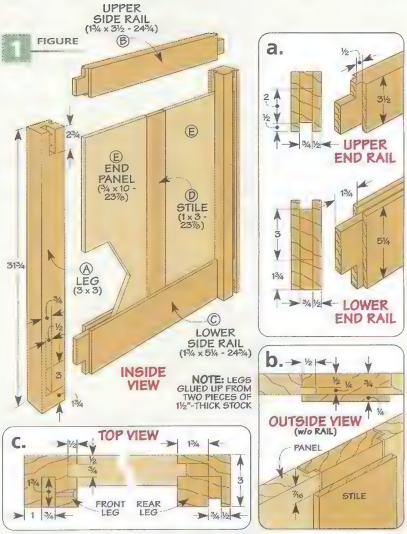
The important thing to keep in mind when laying out the grooves and mortises is that the legs aren't identical. The right-hand legs and left-hand legs mirror each other. And there are differences between the front and rear legs as well.

The rear legs have grooves on *both* inside faces. And the inside face of the front legs has an open mortise at the top. The open mortise allows you to remove the upper stretcher and install the drawer cabinets. (Or remove them if you ever want to move the bench.) This stretcher is screwed in place, so now is also a good time to drill the holes for those screws (Figure 3).

Adding the Rails. The legs are connected by a pair of 1½"-thick rails at the top and bottom. Once the rails are cut to size, you can start on the joinery.

I started by cutting a centered groove along the inside face of each rail. This groove is identical to the grooves cut earlier in the legs.

With the grooves complete, you can turn your attention to the tenons on the ends of each rail. What you need to keep in mind here is that these tenons are "haunched." All this really means is there's a little extra stub at the top of

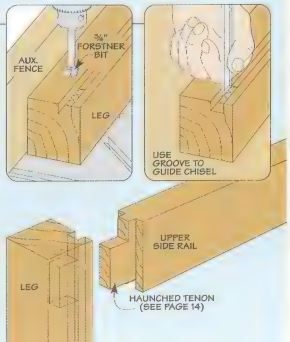


Making a Mortise

The nice thing about most of the mortises for the workbench is that laying them out is a snap. After cutting the grooves in each leg, you can use the shoulders of the groove as a reference for the sides of the mortise when drilling out the waste.

I used my Forstner bit as a guide to set the auxiliary fence on my drill press before drilling out the waste, as in the drawing at right. Once most of the waste is removed, a chisel makes quick work of cleaning and squaring the mortise (far right drawing).

But the mortise is only half the battle. For more on the haunched tenon that completes the joint (lower drawing), turn to page 14.



the tenon that fills the groove at the top and bottom of the leg. You can read more about how to cut a haunched tenon on page 14.

Stiles & End Panels. With the work on the rails complete, you're ready to make the last couple parts before assembling the frames. You'll need a stile and pair of panels for each frame. All the information for this work is shown in Figures 1 and 1b.

The stiles are rabbeted on each end to fit the grooves in the rails. And a rabbet on the *inside* edge of each panel fits into a groove cut in the edges of the stiles. To account for changes in humidity, be sure to allow for a 1/16" gap along the sides of each panel.

Connecting the Frames. After gluing up each frame, you can start work on connecting the frames together. In Figure 2, you can see how the ends are joined with a lower front stretcher and a frame and panel back assembly.

Constructing the back assembly is just like making an end frame. The only differences are adding a couple more stiles and solid wood panels. One thing to note is that the two lower stretchers each have a groove cut along the inside face (Figure 2a). These grooves will accept a set of cleats that support the bottom of the workbench, as illustrated in Figure 3b.

Assemble the Base. Once you have all the parts for the back assembly and the front stretcher complete, you can assemble the base. Because of the length of the bench, you will need some pretty long clamps. The nice thing is, you only need three — one along each of the stretchers.

Final Details. At this point, completing the base is just a matter of adding a bottom, a set of support cleats, and an upper stretcher. Figure 3 provides all the information you'll need.

To fit the cleats in place, angle them slightly and pivot them into the grooves. Then, you'll have to notch the corners of the bottom before setting it in place.

Now, all that's left to do is add the upper front stretcher. After rabbeting each end of the stretcher to fit the mortise in the front legs, simply screw the stretcher in place. This way, you can remove it when you install the drawer cabinets.

FIGURE 2

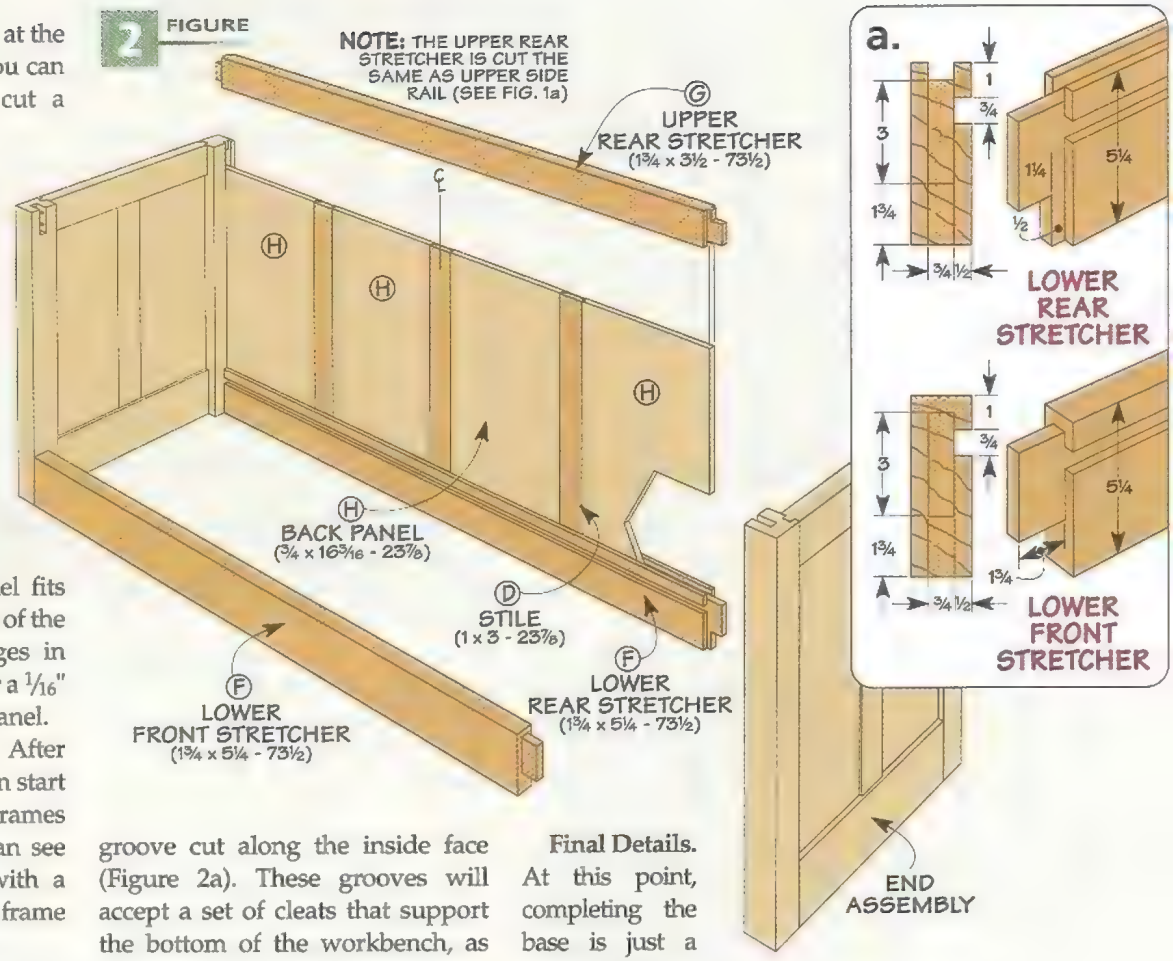
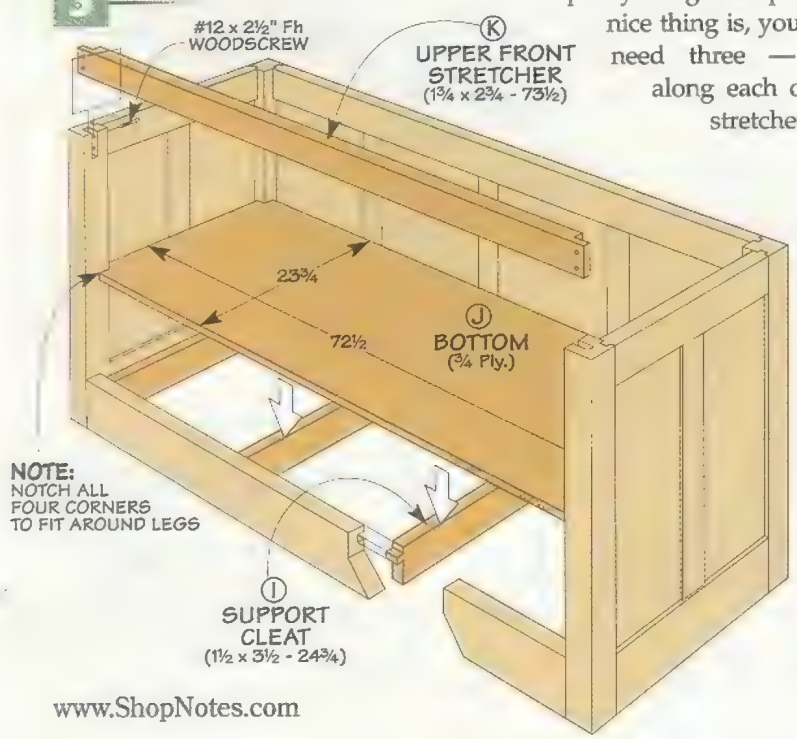
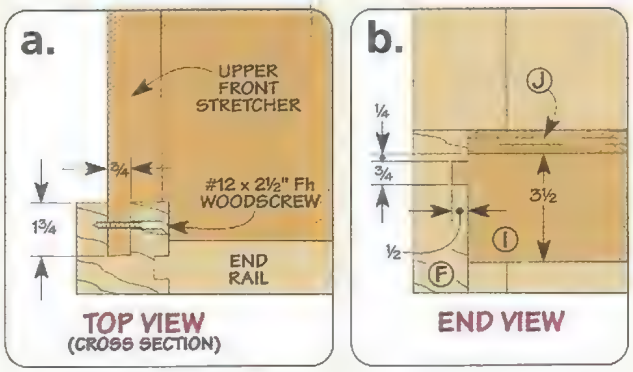
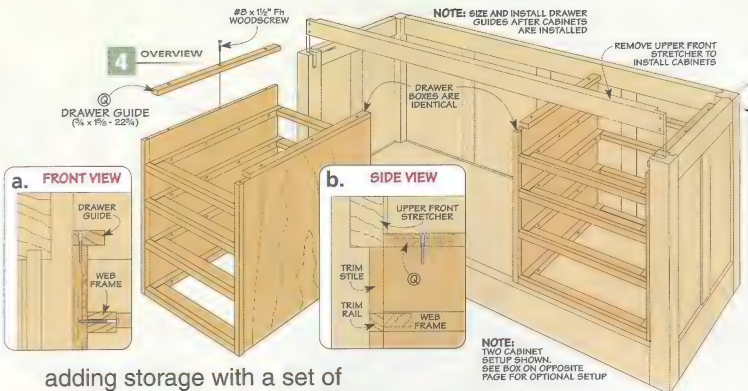


FIGURE 3







adding storage with a set of

Drawer Cabinets

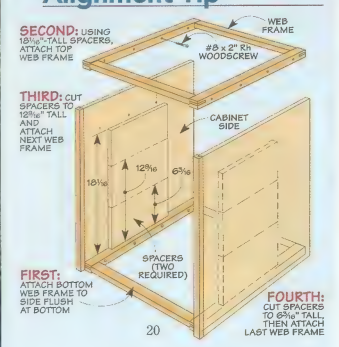
You could leave the base of the workbench open if you'd like, but adding a storage system is one of the best ways to keep all the tools and supplies you'll be using organized and close at hand.

I built a couple cabinets that each hold a set of four drawers, like you see above. Later, the space between the cabinets will be enclosed by a pair of doors. Or instead, you can add additional drawers by checking out the box at the bottom of the opposite page.

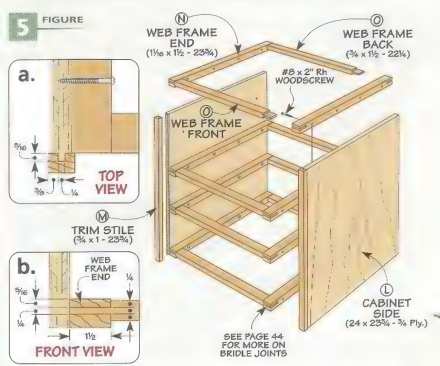
Adding a Drawer Cabinet. The nice thing about the cabinets is that they're identical and consist of only a few modular components: two side panels, four web frames, and some trim pieces (Figure 5).

The sides are just pieces of ¾" plywood. To cover up the edges, I used a tongue and groove joint to add a solid wood trim piece to the front edge. If you take a close look at Figure 5a, you can see how the trim piece extends past the inside face of the plywood. This provides a solid stop for locating the web frames that are added next.

Alignment Tip



5 FIGURE



Web Frames. In keeping with the classic style of an old-time workbench, the drawers rest on wood web frames instead of metal drawer slides. Besides supporting the drawer, the frame above each drawer acts as a guide to prevent the drawer from tipping as it's pulled out of the cabinet.

Each web frame consists of a pair of thick ends joined to a thinner front and back. A quick look at Figure 5 shows how a bridle joint is used to assemble the front and back to the ends. This is an easy joint to cut on the table saw and the large gluing surface makes for a solid assembly. For more on bridle joinery, turn to page 44.

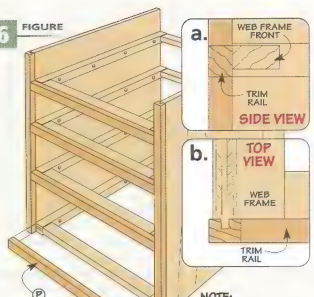
You'll also notice in Figure 5b that the front and back pieces aren't flush with the ends along the top edge. This offset ensures the drawers are supported on just the ends of the web frame and keeps the drawer front from rubbing against the trim rail and front piece of the web frame.

Assemble the Cabinet. With the web frames complete, the next step is to attach them to the sides. I spaced the frames to allow for graduated drawers joined with half-blind dovetails. But you can space them any way you'd like. The only thing to keep in mind as you do this is to maintain a consistent gap around the edges of each drawer.

To ensure the frames were level from side to side, I started by screwing the bottom frame in place so it was flush with the bottom edge of the sides. Then I used a pair of identical spacers to install the remaining frames, as shown in the box on the opposite page.

Trimming it Out. To complete the cabinets, all that's left to do is add the solid wood trim pieces shown in Figure 6. The trim pieces are cut to fit between the sides of the cabinet and are glued in place so the top edge is flush with the top face of each front piece (Figure 6a).

Install the Cabinets. With the cabinets complete, you can set them inside the base of the workbench (main drawing on opposite page). You'll need to remove the upper front stretcher to do this.



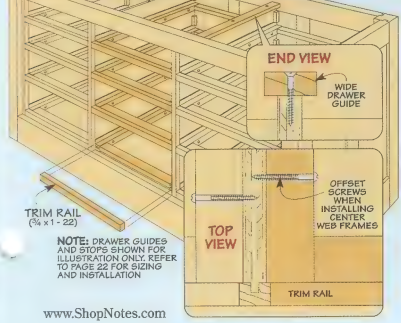
Once the stretcher is back in place, there's one last thing to do. And that's to install a pair of drawer guides on each cabinet (Figure 4). These guides serve two purposes. First, they lock each cabinet in place, preventing it from sliding front to back. And second, the guides prevent the upper drawer from tipping as it's pulled out.

Optional Set of Drawers

If you'd like to add a third set of drawers to the workbench, all you need to do is make a few more web frames and trim pieces (see drawing).

Size the Frames. The first step is to build the frames to fit the opening between the cabinets. To install each frame, you'll need to slide it down between the cabinets and then screw it in place (see Top View at left).

Trim & Drawer Guides. With the frames in place, you can add the trim rails as before. Finally, to keep the upper center drawer from tipping as it's pulled out, make wider drawer guides for the top.



adding the

Drawers, Doors, & Shelves

As I mentioned earlier, the position of the web frames that make up the drawer cabinet sets the opening for each drawer and therefore its size. So before you start building the drawers, the only thing to determine is the type of joinery you want to use to assemble them.

Half-Blind Dovetails. I used half-blind dovetails to assemble my drawers, like you see in Figure 7. But the box at the bottom of the opposite page shows an optional drawer joint you can use.

Regardless of the type of joint you decide on, it's always a good idea to double-check the measurements for each of the drawer openings. Then, after allowing for a 1/16" gap around all the edges, you can cut all the parts to size and complete the joinery.

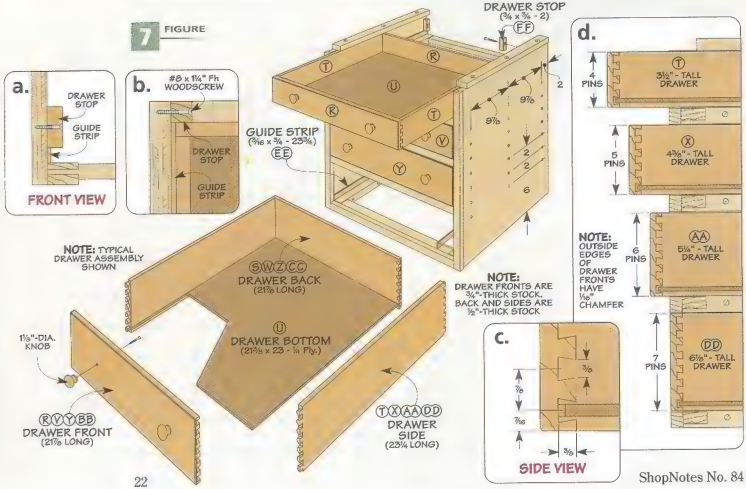
Add the Bottoms. With the joinery complete, the next step is to cut a groove on the inside face of each part for the 1/4" plywood bottom. This groove is centered on the bottom pin of the drawer sides (Figure 7c). This way, it won't be visible on the sides once the drawers are assembled.

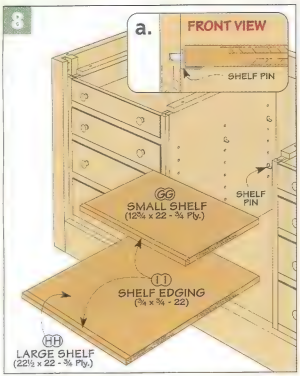
After cutting all the grooves, you can trim the drawer bottoms to size and glue up the drawers. Then, just add a pair of knobs to each drawer.

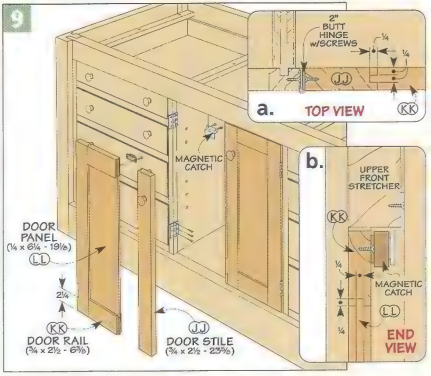
Guide Strips & Stops. Now that the drawers are complete, you're just about ready to install them in the cabinets. But first, to keep the gaps consistent from side to side and allow the drawers to slide smoothly, I added guide strips to the cabinet. These thin strips are simply glued to the sides of the cabinet, as in Figure 7a.

Once the strips are in place, you can add drawer stops to the cabinet. The stops are glued and screwed in place (Figure 7b) so the face of each drawer front ends up flush with the front of the cabinet.

7 FIGURE







ADDING SHELVES

If you chose to leave the center compartment open, now is a good time to add the shelves. You can make full shelves or half shelves — or one of each, like I did (Figure 8).

Make the Shelves. Each shelf is just a piece of ¾" plywood with a strip of solid wood glued to the front. Just be sure to account for the shelf pins when you trim the shelf to final length (Figure 8a).

Once the shelves are complete, you can drill the holes for the shelf pins (Figure 7) and then set the shelves in place.

FRAME & PANEL DOORS

To enclose the center compartment and hide the contents of the shelves, I added a pair of frame and panel doors (Figure 9).

Each door consists of a pair of stiles and rails joined with stub tenon and groove joinery (Figures 9a and 9b). To maintain a consistent gap around the doors, size them to fit the opening, then trim each door to create an even 1/16" gap all around.

The panel for each door is made up by edge gluing stock and then planing it to final thickness. After trimming the panel to size (allowing for expansion and contraction), you can glue up the doors. To allow the panel to move, don't glue the panel in place.

Cut the Hinge Mortises. To install the doors and establish consistent gaps, you'll need to mortise the hinges into the door stile. Once that's complete, you can screw the doors to the sides of the cabinets.

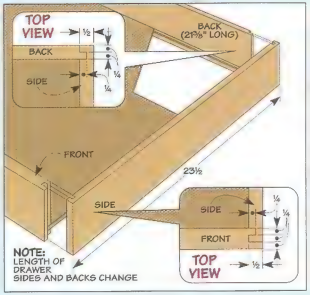
Adding the Hardware. At this point, there isn't too much left to do to complete the installation of the doors. I used the same knobs on the doors as I did on the drawers (Figure 9). And to hold the doors securely closed, I screwed a strike plate to the upper stretcher and then attached the magnetic catch to the top inside corner of each door, like you see in Figure 9b.

Optional Drawer Joinery

You don't need a dovetail jig to build strong drawers. Instead, you can use locking rabbet joints and tongue and dado joinery to make the drawers of the workbench.

At the front of the drawer, I used locking rabbet joints. Since the front takes most of the abuse of opening a drawer, a locking rabbet joint provides a solid connection to the sides of the drawer while hiding the joint from view. And then to join the back and sides together, I used a tongue and dado joint.

The only thing to keep in mind as you size the sides and back is that their lengths change as a result of the optional joinery.



The heart of this workbench is the large top with its vises and bench dogs that allows you to work on just about any size or type of project.

Making the Top. I started on the top by gluing up a few wide boards and then wrapping them with wide aprons (Figure 10). To keep the surface and edges as flush as possible, I used ¼" hardboard splines to join the pieces. (For more on spline joinery, turn to page 8.)

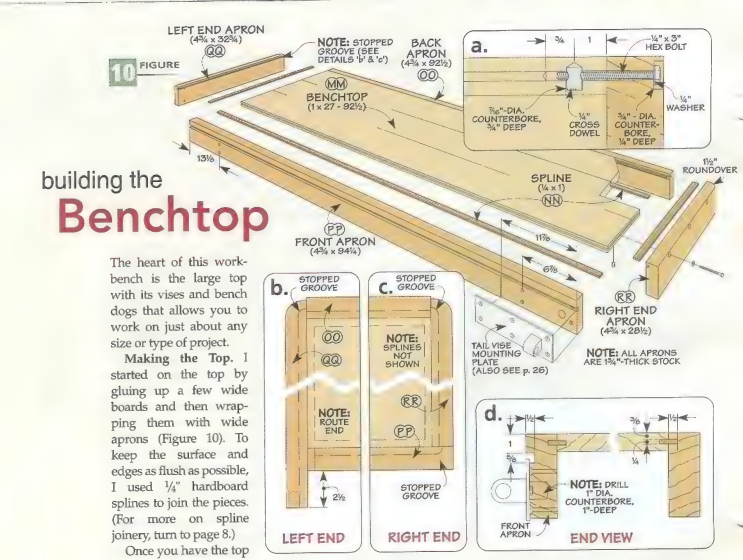
Once you have the top glued up, you can square up the ends as you trim it to final length. For a handy tip on doing this safely and accurately on the table saw, check out page 14.

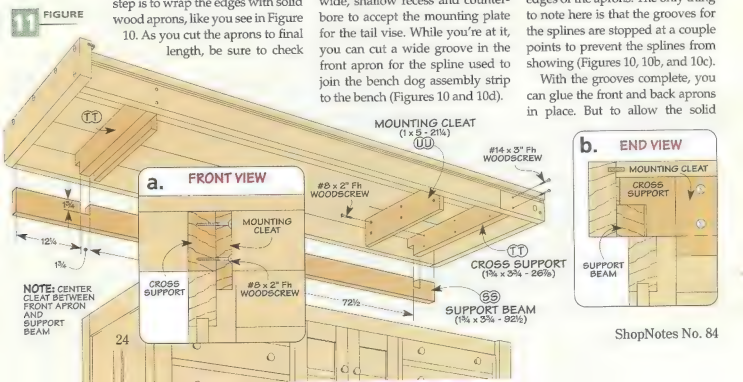
Adding the Aprons. The next step is to wrap the edges with solid wood aprons, like you see in Figure 10. As you cut the aprons to final length, be sure to check Figures 10b and 10c to see how they wrap around the top.

In Figure 10 you can see that the back corners of the end aprons are rounded. And the front apron has a wide, shallow recess and counterbore to accept the mounting plate for the tail vise. While you're at it, you can cut a wide groove in the front apron for the spline used to join the bench dog assembly strip to the bench (Figures 10 and 10d).

Now you're just about ready to attach the aprons to the top. But first, you'll need to cut grooves for the splines completely around the benchtop and along the inside edges of the aprons. The only thing to note here is that the grooves for the splines are stopped at a couple points to prevent the splines from showing (Figures 10, 10b, and 10c).

With the grooves complete, you can glue the front and back aprons in place. But to allow the solid





wood top to expand and contract, the end aprons are attached with bolts and cross dowels (Figure 10a).

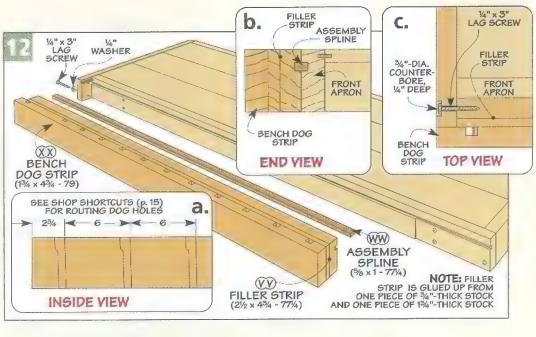
Supporting the Top. At this point, you can turn your attention to providing the structure that supports the top and allows you to attach it to the base of the workbench.

In Figure 11, you can see how a notched support beam accepts a pair of cross supports. Because the top is a solid wood panel, the mating notches will allow the supports (and top) to move without any problem (Figure 11b). Plus, the notches help position the supports right over the upper rails of the end frames of the base (Figure 11a).

To install the supports, slip them in place as you glue the support beam to the back apron and top. Then, secure the supports at the front by screwing through the front apron. Finally, attach the mounting cleats that prevent the top from shifting front to back and side to side as you work, as in Figure 11a.

Bench Dog Assembly. At this point, you're ready to build up the front edge of the bench with a heavy-duty bench dog assembly.

To start with, I glued up a thick filler strip and planed it down until it was flush with the end of the left apron, like you see in Figure 12c. After cutting a groove to match the one in the top, the strip is simply glued in place with a wide solid wood spline (Figure 12b).



All that's left to complete the assembly is to add the bench dog strip (Figure 12). First, you'll need to add the holes for the bench dogs to the strip. I did this with a hand-held router and a shop-made jig. (For more on this, see page 15). Once the holes for the bench dogs are routed, you can glue the strip in place and start getting ready to add the vises.

Materials & Hardware

BASE FRAME

A	Legs (4)	3 x 3 - 31¾
B	Upper End Rail (2)	1¾ x 3½ - 24¾
C	Lower End Rail (2)	1¾ x 5¼ - 24¾
D	Stile (5)	1 x 3 - 23⅞
E	End Panels (4)	¼ x 10 - 23⅞
F	Lower Stretchers (2)	1¾ x 5¼ - 73½
G	Upper Rear Stretcher (1)	1¾ x 3½ - 73½
H	Back Panels (4)	¼ x 16⅛ - 23⅞
I	Support Cleats (4)	½ x 3½ - 24¾
J	Bottom (1)	23¾ x 72½ - ¾ Ply.
K	Upper Front Stretcher (1)	1¾ x 2¾ - 73½

DRAWER CABINETS

L	Cabinet Sides (4)	24 x 23¾ - ¾ Ply.
M	Trim Stiles (4)	¾ x 1 - 23¾
N	Web Frame Ends (16)	1⅛ x 1½ - 23¾
O	Web Frame Frts./Backs (16)	¾ x 1½ - 22¼
P	Trim Rails (8)	¾ x 1 - 22
Q	Drawer Guides (4)	¾ x 1⅜ - 22¾

DRAWERS, DOORS, & SHELVES

R	Small Drawer Front (2)	¾ x 3½ - 21⅞
S	Small Drawer Backs (2)	½ x 3½ - 21⅞
T	Small Drawer Sides (4)	½ x 3½ - 23¼
U	Drawer Bottoms (8)	21⅜ x 23 - ¼ Ply.
V	Medium Drawer Fronts (2)	¾ x 4⅜ - 21⅞
W	Medium Drawer Backs (2)	½ x 4⅜ - 21⅞
X	Medium Drawer Sides (4)	½ x 4⅜ - 23¼
Y	Large Drawer Fronts (2)	¾ x 5¼ - 21⅞
Z	Large Drawer Backs (2)	½ x 5¼ - 21⅞
AA	Large Drawer Sides (4)	½ x 5¼ - 23¼
BB	X-Large Drawer Fronts (2)	¾ x 6⅛ - 21⅞
CC	X-Large Drawer Backs (2)	½ x 6⅛ - 21⅞
DD	X-Large Drawer Sides (4)	½ x 6⅛ - 23¼
EE	Guide Strips (16)	⅜ x ¾ - 23¼
FF	Drawer Stops (16)	¾ x ¾ - 2
GG	Small Shelf (1)	12 ¾ x 22 - ¾ Ply.
HH	Large Shelf (1)	22 ½ x 22 - ¾ Ply.
II	Shelf Edging(2)	¾ x ¾ - 22
JJ	Door Stiles (4)	¾ x 2½ - 23⅛
KK	Door Rails (4)	¾ x 2½ - 6⅛
LL	Door Panels (2)	¼ x 6¼ - 19⅛

BENCHTOP

MM	Benchtop (1)	1 x 27 - 92½
NN	Spline	1 x 450 (Rgh.) - ¼ Hdbd.
OO	Back Apron (1)	1¾ x 4¾ - 92½
PP	Front Apron (1)	1¾ x 4¾ - 94¼
QQ	Left End Apron (1)	1¾ x 4¾ - 32¾
RR	Right End Apron (1)	1¾ x 4¾ - 28½
SS	Support Beam (1)	1¾ x 3¾ - 92½
TT	Cross Supports (2)	1¾ x 3¾ - 26⅞
UU	Mounting Cleat (2)	1 x 5 - 21¼
VV	Filler Strip (1)	2½ x 4¾ - 77¼
WW	Assembly Spline (1)	⅝ x 1 - 77¼
XX	Bench Dog Strip (1)	1¾ x 4¾ - 79

TAIL & FACE VISES

YY	Tail Vise Top (1)	1¼ x 2½ - 20
ZZ	Tail Vise Bottom (1)	¾ x 2½ - 20
AAA	Front Filler (1)	2¾ x 2½ - 2
BBB	Back Filler (1)	2¾ x 2½ - 3
CCC	Tail Vise Strip (1)	1¾ x 4¾ - 20
DDD	Pinch Block (1)	1¾ x 4¾ - 3
EEE	Collar Support Block (1)	1¼ x 2½ - 16
FFF	Face Vise Block (1)	3½ x 7⅞ - 16

- (64) #8 x 2" Rh Woodscrews
- (12) #8 x 1½" Fh Woodscrews
- (12) #8 x 2" Fh Woodscrews
- (16) #8 x 1¼" Fh Woodscrews
- (8) #10 x 1¼" Fh Woodscrews
- (6) #12 x 1¼" Fh Woodscrews
- (4) #12 x 2½" Fh Woodscrews
- (3) #14 x 1½" Fh Woodscrews
- (6) #14 x 3" Fh Woodscrews
- (7) ¼" x 3" Lag Screws
- (3) ¼" x 4" Lag Screws
- (6) ¼" x 3" Hex Bolts
- (16) ¼" Washers
- (6) ¼" Cross Dowels
- (8) Shelf Support Pins
- (2 Pr.) 2" Antique Hinges w/Screws
- (18) 1⅛"-Dia. Knobs w/Screws
- (2 Pr.) Magnetic Catches w/Screws
- (1) Face Vise Hardware and Handle
- (1) Tail Vise Hardware and Handle
- (1 Pr.) Bench Dogs

outfitting the

Vises

Vises can make or break a workbench. But don't worry, the vises you see here are rock-solid and will handle the most demanding tasks with ease. Note: For more on bench vises, turn to page 38.

COMPLETING THE TAIL VISE

At first glance, the tail vise at right looks like a solid block of wood. But what's interesting is what you don't see. And that's the metal hardware on the "inside."

In Figures 13 and 14, you can see that the key pieces of hardware are the mounting plate attached to the front apron and the two guide plates that sandwich it. As you turn the handle, these plates guide the assembly smoothly as it travels back and forth.

For the most part, the rest of the parts of the vise assembly keep the plates spaced correctly. The secret to adding them is to trial fit everything as you go along. So you'll need to disassemble and then reassemble the tail vise a few times.

Mounting the Plate. The first thing you'll need to do is attach the tail vise mounting plate (Figure 13). This plate fits into the recess in the front apron and is screwed in place so the top edge extends just above the bottom edge of the apron groove, as in the End View at left.

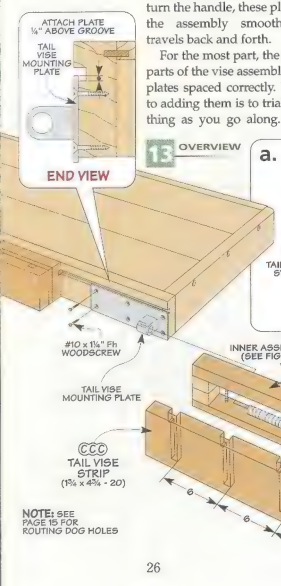
Once the plate is in place, the next step is to size the tail vise top and attach the metal guide plate of the tail vise. What you're looking for here is to end up with the tail vise top flush with the top of the bench when the guide plate is hooked over the mounting plate (Figure 13a). And there shouldn't be any gap between the apron on the bench and the edge of the tail vise top.

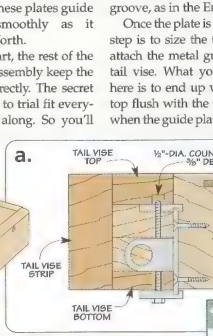
To help locate everything accurately, I clamped the two pieces together and test fit it to the bench. Once you have the tail vise top sized and the guide plate located, you can screw them together.

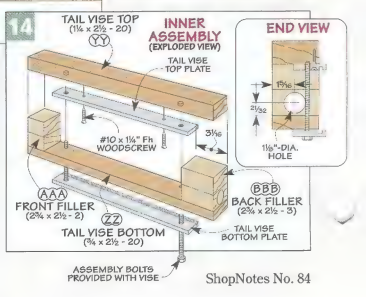
Note: You'll also need to drill a couple counterbores in the tail vise top for the ends of the bolts used to clamp the lower guide plate in place, as in Figure 14. You can use the guide plate to locate them.

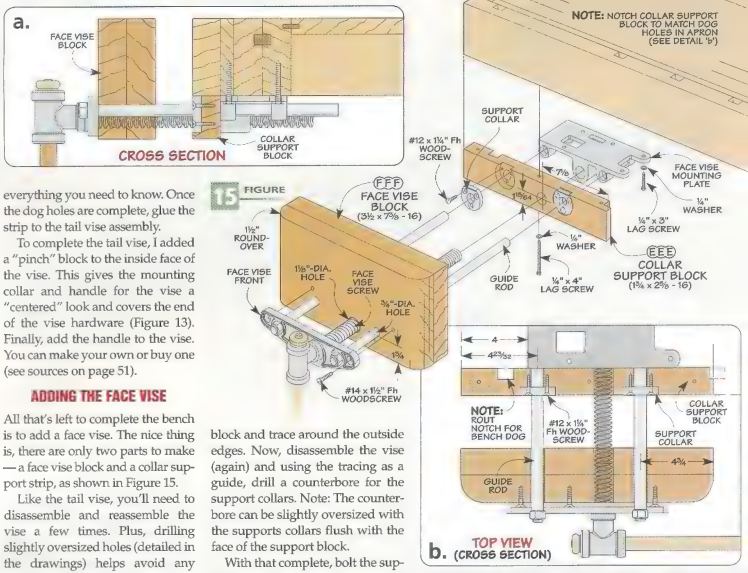
At this point, the critical "assembly" of the vise is over. All that's left to do now is add the two filler blocks and the tail vise bottom. Here again, test fitting will help you size the blocks and bottom piece for a smooth sliding fit.

Add the Bench Dog Strip. At this point, you're ready to add the tail vise strip that holds the bench dogs. As before, page 15 covers









everything you need to know. Once the dog holes are complete, glue the strip to the tail vise assembly.

To complete the tail vise, I added a "pinch" block to the inside face of the vise. This gives the mounting collar and handle for the vise a "centered" look and covers the end of the vise hardware (Figure 13). Finally, add the handle to the vise. You can make your own or buy one (see sources on page 51).

ADDING THE FACE VISE

All that's left to complete the bench is to add a face vise. The nice thing is, there are only two parts to make — a face vise block and a collar support strip, as shown in Figure 15.

Like the tail vise, you'll need to disassemble and reassemble the vise a few times. Plus, drilling slightly oversized holes (detailed in the drawings) helps avoid any alignment problems.

Mounting the Vise. The first step is to disassemble the vise and bolt the mounting plate to the bottom of the bench (Figures 15a and 15b).

The next step is to make the support block for the metal collars that provide extra support for the guide rods (Figure 15). Note: You'll need to cut a couple notches where the strip covers the bench dog holes.

After drilling a pair of oversized holes in the collar support block for the guide rods and screw, bolt the block to the bench, as in Figure 15.

Now, slide the support collars onto the shafts and assemble the vise by feeding the rods through the collar support block, into the vise mounting plate.

At this point, you can slide the support collars up to the support block and trace around the outside edges. Now, disassemble the vise (again) and using the tracing as a guide, drill a counterbore for the support collars. Note: The counterbore can be slightly oversized with the supports collars flush with the face of the support block.

With that complete, bolt the support strip back in place and reassemble the vise. Then, slide the collars into the counterbores and screw them in place.

All that's left to do now is make the face vise block (Figure 15). After gluing up the block and rounding the edges, drill a set of holes for the guide rods and threaded shaft. These holes should align with the holes in the support block. And be sure to locate the holes so the block ends up flush with the left end and top edge of the bench.

After slipping the face vise block over the rods and shaft, tighten the vise to "clamp" the block to the bench. Then simply screw the block in place, as shown in Figure 15b. Then all that's left to do is add a handle to the vise and start working at your new bench.

wood and brass

Spokeshave

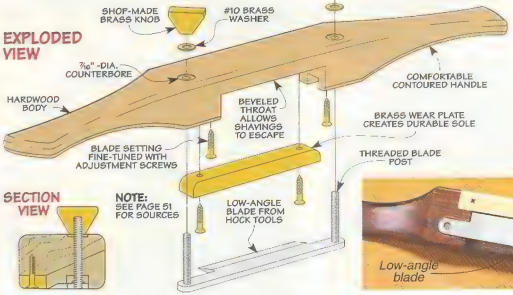
I've always admired the look and feel of the old-style, wood-body spokeshaves that I come across at tool swaps. The design of these spokeshaves is about as simple as can be — often nothing more than a narrow, contoured, wood body holding a small, U-shaped blade.

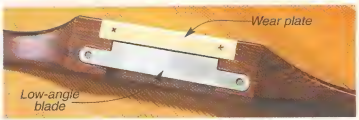
The upshot of this tool envy is the handsome, wood-body spokeshave you see in the photo above. It follows the old design but adds a few nice improvements.

The Anatomy. Take a look at the drawings and photo below to see how the spokeshave is put together. The underside of the contoured body is where the action is. Here, you'll find a narrow blade and a heavy, brass wear plate mortised into the body over a beveled clearance throat.

The high-carbon steel blade I used is at the heart of the upgrades to the traditional design. A threaded post at either end of the blade allows it to be firmly tightened down, and just as importantly, easily adjusted. The wings of the blade rest on a pair of adjustment screws in the blade mortise. So fine-tuning the depth of cut is as simple as a slight turn of the screw.

Next, the brass wear plate in front of the blade isn't just for looks. It creates a durable sole that will stand up to a lifetime of use. Throw in a pair of shop-made brass nuts to tighten down the blade, and you have a tool that looks, feels, and works like a dream.





preparing the Blank

With the blade in hand, you can start by cutting a hardwood blank to size (Figure 1). I used a nice piece of cocobolo, but any dense wood will do. And next, you'll prepare it to accept the blade and wear plate.

The Throat. The first order of business is to form the beveled throat through the center of the blank. This should be a hair wider than the cutting edge of the blade. The box below shows an easy way to get the job done on the table saw.

Fit the Blade. With the throat complete, you can start work on fitting the blade. The cutting edge fits into the recess created by the throat. But you'll need to cut a mortise on either side of the throat for the wings of the blade (Figure 1).

After using the blade to lay out the mortises, a ⅜"-dia. Forstner bit will do the job of forming the end profiles and removing the waste. Note that the blade will rest on the two adjustment screws, so the mortise is deeper than just the thickness of the blade (Figure 1).

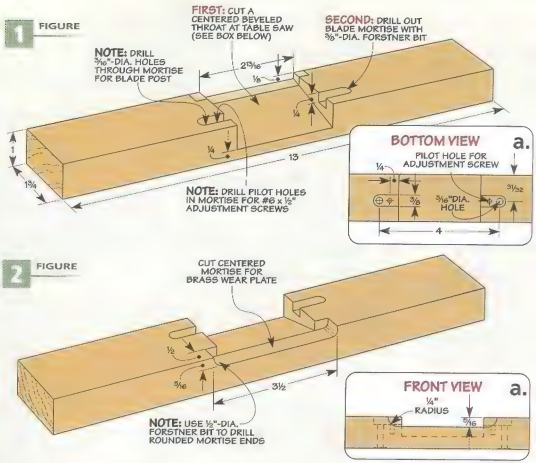
Post Holes. After cleaning up the mortise at the bench, I took the blank back to the drill press. You'll need to drill two accurately placed, 3/16"-dia. holes through the mortises to accept the posts of the blade.

Details. A couple details will complete work on fitting the blade and its hardware. First, I created a hard bearing surface for the knobs that tighten on the blade posts by inlaying washers around the post holes (Exploded View at left). Go ahead and drill the 7/16"-dia. holes now and add the washers later.

Finally, as mentioned, the wings of the blade rest on adjustment screws installed in the mortises. At this point, all you need to do is drill the pilot holes (Figure 1a).

Wear Plate. The wear plate rests in front of the blade and is simply a piece of 5/16"-thick brass bar stock mortised into the body and held in place with a couple of brass screws. You can cut the recess now and then fit the wear plate after the body has been shaped.

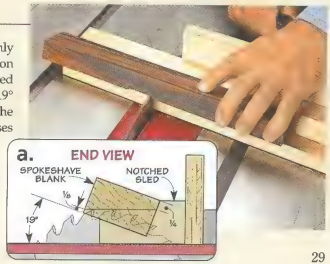
I used a ½"-dia. Forstner bit in the drill to form the rounded ends of the mortise (Figure 2a). To complete the work, I took the blank to the bench and chiseled out the waste. And at this point, the blank is ready to get its final shape.



Cutting the Throat

The photo and drawing at right show how to cleanly and accurately cut the beveled throat in the blank on the table saw. The trick is to use a notched sled clamped to the miter gauge to hold the blank at a 19° angle to the table, as shown in detail 'a.' Then the throat can be quickly cut by making multiple passes across the saw blade.

To use the sled, lay out the throat on the front of blank. Now, with the blank in place, raise the blade between test cuts to reach the final depth. After nibbling away the waste, follow up with a rasp and sandpaper for a perfectly smooth surface.



SHOP TIP

shaping the Body

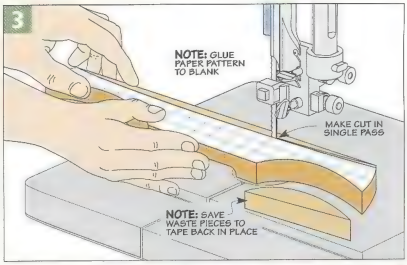
One of the marks of a fine tool is the way it feels in your hands. So now that the blank has been readied for the business part of the spokeshave, the next task is to give it a shape that feels just right and gives you the best control.

The Shape. The profile that I used is shown in the patterns at the bottom of the page. As you can see, the slim handles are contoured on all four sides for a comfortable grip. But this means that cutting the body to shape takes a little bit of advanced planning. The key is doing things in the right order.

To get started, I cut out a full-sized top pattern and side pattern and glued them right to the blank. This makes it very easy to follow the layout lines when cutting the blank to shape at the band saw.

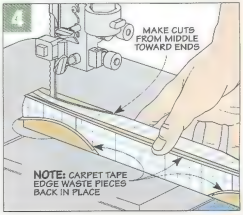
Since you've already cut the mortises for the "hardware," you'll want to make sure you get the two patterns attached in the right orientation. And note that I glued the side pattern to the long, curved edge of the blank (the back side).

Making the Cuts. The pattern drawings below also show the order of the cuts. First, with the bottom of spokeshave flat on the band saw table, cut the two deep curves of the handles, followed by the two ends. And next comes the sweeping curve along the back of the spokeshave as shown in Figure 3.



A Little Tape. When you remove these waste pieces, do it with one continuous cut. You want to have the pieces intact so you can carpet tape them back in place to complete cutting the body to shape.

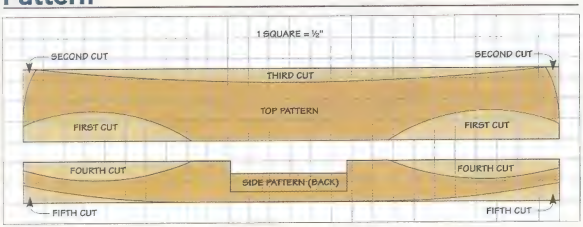
The long waste piece from the back of the blank now holds the pattern, so be sure to get it aligned properly when you reattach it. The two short curved pieces will help provide a little more stability.



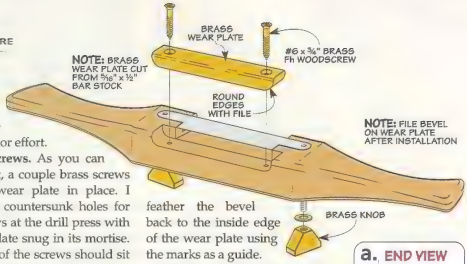
The Final Cuts. With the waste reattached, you're ready to finish up. I made the cuts on the bottom next, starting near the middle and cutting out to the ends (Figure 4). Since the end profiles have already been cut, you're missing a little bit of the pattern. But once you've established the curve, it's a simple matter to follow it to the end of the blank. Then the final two cuts can be made the same way.

Smooth and Rounded. When the work at the band saw is done, you can take the body back to the bench to add a few refinements to the shape. First, I used a cabinet file and sandpaper to smooth the band saw cuts. After this was done, I spent some time rounding off all the sharp edges. Remember, what you're shooting for is a comfortable grip. So I gave special attention to rounding all the edges of the handles. And once you think the spokeshave feels just right in your hands, you're ready to add the brass parts to the body.

Pattern



adding the Brass



5 FIGURE

Now, you're down to adding a few small but important parts. The wear plate needs to be fitted to the body and then you can make a pair of custom brass knobs.

Wear Plate. First comes the brass wear plate. And I took this slow to get the best possible fit.

Both the wear plate and the knobs are cut from a short length of 5/16" x ½" brass bar stock. You'll find a couple of sources on page 51.

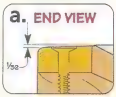
You can start by cutting a section just slightly longer than the length of the wear plate mortise. Then I picked up a file to square the ends and trim the blank to fit snugly into the very top of the mortise.

To complete the fit, you'll need to round the inside corners of the plate until it seats tightly in the rounded mortise. The best way to do this is to file the corners a bit and then test the fit. Just repeat the process until you like what you see. The brass works easily, so this won't take much time or effort.

Brass Screws. As you can see at right, a couple brass screws hold the wear plate in place. I drilled the countersunk holes for these screws at the drill press with the wear plate snug in its mortise. The heads of the screws should sit flush with the surface.

A Slight Bevel. With the wear plate in place, one important task remains. In order for the spokeshave to take a shaving, the wear plate needs to bevel very slightly toward the front edge (Figure 5a). This allows you to tip the body forward to get the edge of the blade started into a cut.

To create the bevel, first I highlighted the bottom surface of the wear plate with a dark marker. Then starting at the outside edge, I filed across both the body and the wear plate. You'll only need to go about 1/32" deep at the front. Then feather the bevel back to the inside edge of the wear plate using the marks as a guide.



After completing the bevel, I took a few passes across the front edge of the body with the file to make sure the wear plate and body were perfectly flush. And then, I eased the leading edge with a slight roundover. Finally, I polished the whole works by sanding with 220-grit, then 320-grit, and then an ultra-fine sanding pad.

And after installing the two brass adjustment screws, all you need are a couple knobs. Check the box below for the details on this. Then after a couple coats of spray lacquer, you can turn the page for tips on making fine shavings.

Custom-Made: Brass Knobs

Tap the Knob. After drilling a pilot hole on the drill press, the brass bar will tap cleanly and easily.

The blade that I ordered came with small, brass nuts for tightening down the blade. But I decided that a pair of easy-to-grip, custom-made knobs would work better.

The knobs are made from the same bar stock as the wear plate. The trick to making them was to do most of the work while they were still attached to the longer bar.

I started by laying out a knob on the squared end of the bar (see dimensions on photo above). Then I drilled an appropriately sized pilot hole at the drill press and tapped threads into the knob (left photo).

Cut It Loose. You'll want to make the [illegible] chamfer cuts before the [illegible] square cut re[illegible] knob [illegible]

Now, with the bar still tightly clamped in the vise, you can start cutting the knob to shape. First, I cut the chamfer on the square end of the bar. Next, you can cut the opposite chamfer, stopping at the intersecting layout line. A final short, square cut will free the knob from the bar. And once loose, the knob can be finished up with a file, some fine sandpaper, and a coat of lacquer.

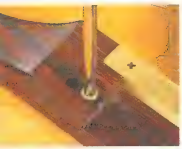
using a

Spokeshave

A spokeshave works great on some of the shaping chores you might otherwise tackle with sandpaper or a rasp. The advantage is that it removes wood faster and leaves a cleanly cut surface. All that's required is the right technique.

A Fine-Tuned Blade. Before trying to take any shavings, you'll want to do some work on the blade. There are two parts to this.

First, as with any edge tool, the sharper the better. My *Hock* blade arrived with a pretty keen edge, but that didn't stop me from honing it to a bright polish before putting it to use. The shape and configuration of the blade make this a bit of a challenge. The box at the bottom of the opposite page shows how I got the job done.



▲ *A Turn of the Screw. A very fine turn of the adjustment screws is all it takes to raise or lower the blade.*

Next, the sharpened blade needs to be finely adjusted. The mechanics here are simple (margin photo). The two adjustment screws are turned in or out to lower or raise the blade. Then you can reinstall the blade to check its height.

The goal is a "hair's width" of the cutting edge exposed beyond the wear strip. This will give you the fine shavings you're after. Just use sight and feel to get it right.

Another Option. For most jobs, I set the blade to take an even cut along its length. But I should mention there is another adjustment option. At times, I'll raise the blade a touch on one side. This lets you rough out a shape with heavier cuts on the "high" side, and then smooth the surface with fine shavings taken with the opposite edge.

▲ *Push or Pull — Always Downhill. The spokeshave can be pushed away from your body, as in the inset photo, or pulled toward it (main photo). But the key is to always cut with the grain or "downhill."*

BODY LANGUAGE

With the sharpened blade finely adjusted, you have a good start. Next comes a few basics on handling a spokeshave.

The Grip. You'll find that a firm, but not too firm, grip gives the best control. A look at the photos on this page will give you the idea.

For a push or a pull cut (I'll talk about this later) the grip is essentially the same. The thumbs rest on the near side of the body. The index fingers are placed near the front, top edge and are used to steer the cut and apply downward pressure. The other fingers are wrapped lightly around the handles. And the palms can add a little extra pressure when needed.

Push or Pull. When you ask spokeshave users whether they prefer to push the shave away from their bodies or pull it toward them, you'll get about a 50/50 split. I've tried both and found the choice depends a lot on the job at hand. In fact, at times I find myself using both a push and a pull stroke on a workpiece (photos at left). My advice is to try it each way and see which feels "natural" and gives the best results. The nice thing is that the tool is "reversible" and works just as well either way.

MAKING SHAVINGS

Now all that's left is putting the shave to work. And here, there are a couple things to keep in mind.

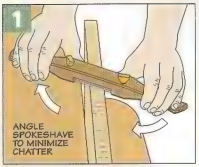
Simple Tips. Since the sole of the spokeshave doesn't have much contact with the workpiece, you'll need to use firm downward pressure. This is one of the keys to a smooth cut. And as with most other edge tools, cut with the grain. With contoured pieces, this often means you'll have to cut from both directions (photos at left).

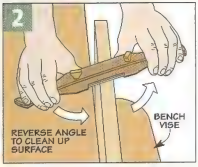
Shavings. To start a cut, lay the spokeshave on the surface and then tip it slightly forward so that the wear strip is flat on the surface. (Remember the bevel.) This slight forward lean allows the cutting edge of the blade to bite into the wood and start lifting a shaving. Now, with a steady push (or pull), the spokeshave will start to lift a fine shaving. When you reach a stopping point, just tip the spokeshave up and out of the cut.

You can easily "feel" a clean cut. The spokeshave glides smoothly and easily over the workpiece edge as a fine shaving curls out the back.

Clean Endgrain. One of my favorite things about this spokeshave is that it handles all types of cuts. With the right approach, you'll get fine shavings and a cleanly cut surface on endgrain.

Since endgrain offers more resistance, you'll need to apply more muscle. You can also lighten the cut by tilting the spokeshave slightly to one side. Then tilt in the opposite direction for the next pass (Figures 3 and 3a). You'll end up with a smooth, square edge.





TAMING CHATTER

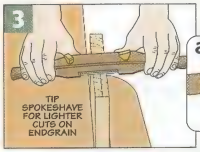
Chatter is the enemy of a smooth cut. It feels just like it sounds. Rather than gliding smoothly across the surface, the spokeshave bounces along, leaving a rough, bumpy trail. And a little chatter sets up a "washboard road" effect for the following cuts.

When you experience chatter, there are several things you can do. First, check the blade setting. The finer the cut, the less resistance *and* chatter you'll encounter.

Next, remember that firm pressure will keep the blade in contact with the edge and chatter can't get started. You might try switching from a push to a pull stroke or vice-versa for better control.

A final strategy is to skew the spokeshave in opposite directions on successive cuts as shown in Figures 1 and 2. Varying the angle between passes, allows the blade to "top off" any bumps or roughness left from the previous cut.

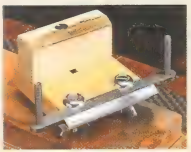
If you're like me, once you get a feel for using a spokeshave, you'll find yourself putting it to work more and more often.



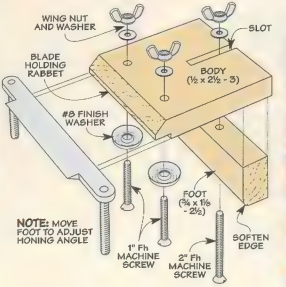
Honing the Edge

When sharpening the spokeshave blade, the goal is no different than with any other edge tool. First you want to flatten and polish the back side of the blade. Next, you hone the 25° bevel to a razor-sharp edge. The problem is that without a good way to get a grip on the narrow blade and its protruding posts, this second step can be troublesome.

The solution to the problem is the adjustable honing guide you see in the photos and drawing below. It simply does what your fingers can't do and snugly grips the blade at just the right angle. And putting a fine polish on the cutting edge is a simple matter.



▲ *A Razor-Sharp Edge. A pair of finish washers hold the blade tightly in the jig allowing you to easily hone the cutting edge.*



drill press

Accessory Cabinet

Customize your drill press storage with this handy cabinet that keeps everything easy to find.

A drill press is one of the most versatile machines in my shop. The problem is keeping track of all the bits and accessories that go with it. That's why I came up with the cabinet pictured above.

One feature I like is that the low profile allows me to hang it near my drill press and not worry about it getting in the way (see inset photo above). Also, the adjustable racks can be set to best maximize the storage space. And some of the racks can be pulled out so you can take them with you to work on a project at your workbench.

An optional lower cabinet provides even more storage. And the drop-down door offers a handy extra worksurface. For more on this, turn to page 37.

building the
Case

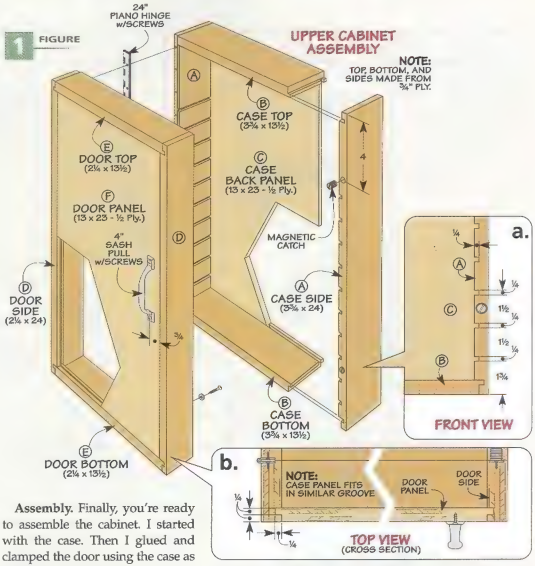
The cabinet is essentially two boxes held together by a piano hinge (see Figure 1). You'll notice the big difference between the two boxes is that one has matching dadoes in its sides for the adjustable racks.

The Joinery. To start building the cabinet, the first thing to do is cut the parts for the top, bottom, and sides for the case and the door. I cut them from a single extra-wide piece. This makes it easy to cut the joinery for both the door and the cabinet at the same time. The joinery is tongue and dado, a fairly simple joint that's strong and sturdy. The box below shows how it's cut on the table saw.

Final Cuts. Once the joinery is done, you can rip the case parts to their final widths. Then, set up your table saw to cut the matched dadoes in the case sides that the removable racks will fit into (see Figure 1a). What's important here is to keep the dadoes aligned and sized, so the ¼" hardboard bottoms of the racks will slide easily.

At this point, you're ready to cut the grooves that hold the door panel and the back panel of the case, as shown in Figure 1b. And after cutting the two panels to size, you can rabbet them to fit the grooves you just cut.

FIGURE 1



Assembly. Finally, you're ready to assemble the cabinet. I started with the case. Then I glued and clamped the door using the case as a reference to keep it square.

Before you attach the door to the case, you'll need to rout rabbets in the case and the door for the piano hinge to fit into. By putting the hinge in rabbets, the door will close snug against the case. Once that's done, you can screw the piano hinge, the door handle, and the magnetic catches in place.

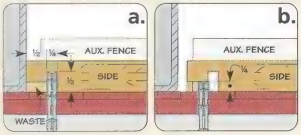
With the cabinet complete, you're ready to make the accessory racks.

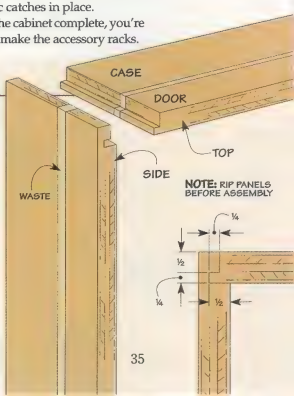
Tongue & Dado Joint

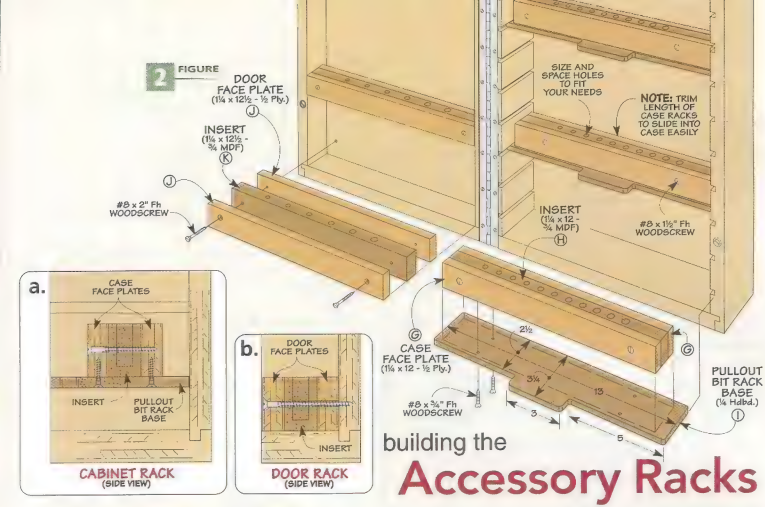
I used a tongue and dado joint to assemble the cabinet because it has good holding power and everything lines up almost automatically when you start putting it together.

Cutting this joint is a simple three-step process on the table saw. The first step is to cut a dado at the top and bottom of each side for the tongue, like in detail 'a' on the left.

The second step is to lower the blade and cut away the waste, as you can see in detail 'b.' Finally, cut a small tongue on the ends of the top and bottom pieces to fit the dadoes cut in the sides, as you see in the main drawing on the right.



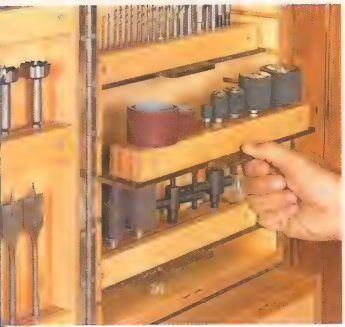




building the Accessory Racks

As I mentioned earlier, one of the great things about this cabinet is the accessory racks. You can move the racks around to maximize storage. And some of the racks can be removed and carried with you wherever you need them.

Another nice feature about the racks is that the inserts (the parts that actually hold the bits) are easy to change out as your collection of accessories grows.



Each rack is basically a piece of MDF sandwiched between two pieces of plywood (Figure 2). The door racks are screwed into the door (Figure 2b). The case racks are mounted on hardboard "pullouts" that fit into the dadoes cut into the case sides (photo below).

Organizing the Space. Before you start building the racks, you need to determine what's going into the cabinet and where. For example, since I use my twist bits away from my drill press more than any other accessory, I stored those on a pullout rack.

Next, arrange the accessories on each rack to figure out the spacing you need between them. Some accessories, like sanding drums, take up more room than others. Just remember to leave space on the ends for mounting screws.

And remember to leave enough room above and below the racks to slide the bits in and out. This is especially true for the door racks, since they're not adjustable once you install them.

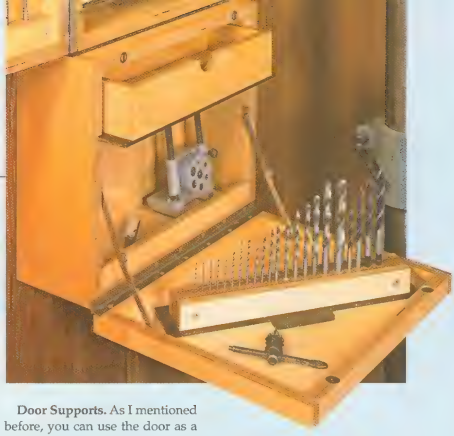
Assemble the Racks. Now that you've determined where everything's going in the cabinet, you can start working on the racks themselves. Since the inserts are designed to be replaceable, you don't want to glue them together.

What I did was cut all the parts for the rack a little long, put the racks together with screws, and then trimmed the assembled racks to final size. (Notice the case racks are a little shorter than the door racks.) Next, drill the holes for the bits. Be careful not to drill all the way through to provide solid support for the bits in the racks.

Installing the Racks. The door racks are simply screwed into place, as you see in Figure 2b. Note: The screws for the case racks are shorter. Now you can center each case rack on a hardboard base (detail 'a') and screw them together.

Finally, you can hang the cabinet next to your drill press by screwing through the back. And for even more storage, you can build the lower cabinet on the next page.

Optional Lower Cabinet



This lower cabinet packs a lot of storage space into a small area — perfect for those few tools that really don't fit in the cabinet. Plus, the drop-down door serves as a worksurface near your drill press.

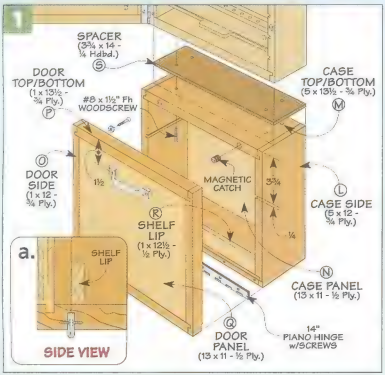
If you look at Figure 1 below, you'll notice that the construction is pretty much the same as the upper cabinet. The only differences are the size of the cabinet and door. And instead of racks, the inside of the lower case has a drawer and a small shelf. I put in a "lip" to prevent bits and other accessories from rolling out.

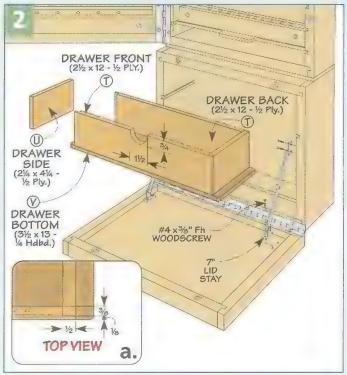
The lower cabinet is screwed to the upper cabinet. But I added a hardboard spacer between them so the upper door will have enough clearance to open and close, as in Figure 1. The spacer is glued to the lower cabinet flush with the back and then it can be fastened to the upper case.

Door Supports. As I mentioned before, you can use the door as a worksurface. To do this, you'll need to install a pair of lid stays to support the door. When you're ready to install them, clamp the door at 90° and screw the stays into the cabinet sides and the door panel. Just make sure these supports clear the lip along the bottom of the lower cabinet when you close the door.

Making the Drawer. The drawer slides on a hardboard base, just like the adjustable racks for the upper cabinet (Figure 2). The drawer is built using simple rabbet joints. And a cutout in the front serves as the pull.

Now you have storage and flexibility for your drill press with this handy cabinet nearby.





All About

Bench Vises

The key to great results when working at your bench is securely holding your workpiece.

What is it that really turns a "bench" into a workbench? For a woodworker, it's a bench vise. More specifically, a face vise and tail vise that allow you to quickly and securely clamp just about anything.

TRADITIONAL FACE VISE

Most woodworkers are familiar with a face (or front) vise. It's the simplest to build in or bolt on to the front edge of just about any workbench.

Vise Sizes. Another reason face vises are so popular is you'll find them in a number of different sizes. By sizing, I mean the maximum size workpiece you can clamp in the vise. The thing you need to keep in mind is that the maximum doesn't take into account any auxiliary wood jaws you may add to the vise. Or how it's installed.

For example, the face vise you see above has a maximum capacity of 13". But that's a bit misleading. In order to securely hold a workpiece, there's a massive wood jaw at the front and a "built-in" jaw at the back — reducing the capacity to 7¾". Still, that's more than enough capability for most woodworking tasks.

Build It In or Add It On. What's nice about this vise is you can build it in to a new bench, or add it on to an existing bench. It's easy because the vise is just an assembly of precision-machined guide rods, a threaded shaft, and pair of heavy-duty castings, as shown above.

To complete the vise and securely hold a workpiece, you need to add a pair of wood jaws. One of the wood jaws attaches to the front of the vise. While the rear "jaw" is formed by the apron of the bench and an extended jaw.

Some larger vises feature steel collars that provide additional support for the guide rods. These collars are attached to a jaw extension below the apron of the workbench.

BOLT-ON FACE VISE

A close cousin to the traditional face vise you see above is the one shown on the opposite page.

What makes this vise different is the metal jaws cast into the vise itself. You can add this to an existing workbench and be working right away by just bolting it in place. But metal jaws can be hard on a workpiece, so it's a good

idea to screw a couple wood jaws in place for protection.

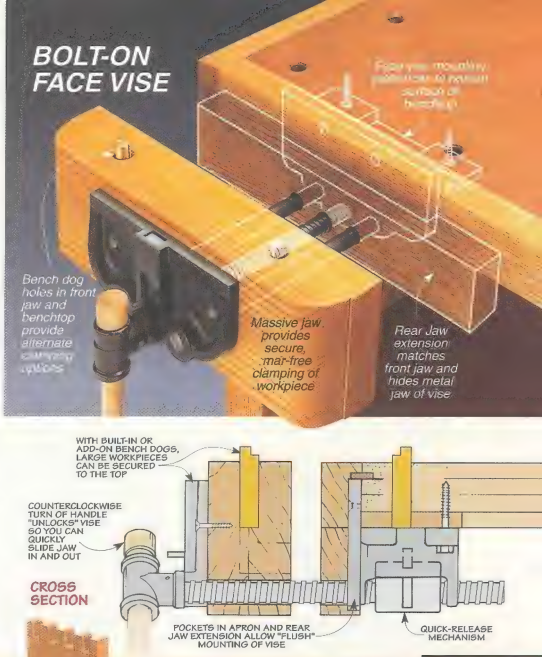
There is one problem with bolting a vise like this in place. If you want to clamp a long workpiece along the front edge, it won't rest flush with the front of the bench. This can make it a hassle to add additional clamps for support.

Building It In. If you're building a new bench, you can solve this problem by "burying" the rear jaw into the apron of the bench (Cross Section at right). By creating a pocket in the apron *before* it's attached to the top, you end up with a built-in wood "jaw."

Quick-Release. One "upgrade" to look for in a bolt-on vise is quick-release feature. With a quick-release, you don't have to spend a lot of time rotating the handle of the vise around and around to open or close the jaws to match your workpiece. You can do it in one quick and easy motion.

The *Jorgensen* vise shown here features a half-nut that releases when you rotate the handle counterclockwise. Other manufacturers use a spring-loaded lever on the front to accomplish the same thing.

The Next Level. A face vise is just one way to make a workbench work harder. For a couple more ways, take a look at the vises on the next page.

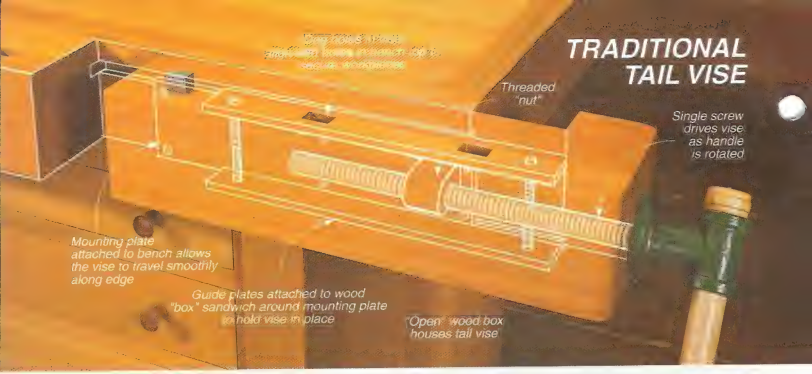


Prevent Racking

About the only problem you'll run across with a face vise is when you clamp a workpiece near one edge, as in the photo at right. As you start applying pressure, the vise begins to rack, or twist, to the other side. Besides being hard on the vise, the jaw won't clamp squarely against the work, so it isn't as secure.

To solve these problems, you can use a handy, "anti-racking" block on the opposite side. The block is just a thick piece of hardwood with a number of "steps" cut into it. To handle workpieces in a wide range of thickness, the steps are graduated in ⅛" increments.

SHOP TIP



working with a
Tail Vise

Although I use my face vise a lot, the vise I couldn't do without is the tail vise installed at the end of my workbench. Whether I need to secure a long workpiece for planing or hold a wide panel for a little belt sanding, my tail vise is up to the challenge.

TRADITIONAL TAIL VISE

A traditional tail vise, like the one you see above, securely clamps a workpiece to the *top* of your workbench, yet still allows you to work without any interference. To do this, the vise has a few dog holes that align with a long row of dog holes in the front edge of the bench. With a pair of bench dogs, holding just about any workpiece is a snap.

Note: For more versatility, you can even clamp a workpiece between the face of the sliding jaw and the bench.

How a Tail Vise Works. Although a tail vise looks like a solid assembly, it's really a wood box with an open back. It's the hardware inside that's the secret to how a tail vise works. To see what I mean, take a look at the illustration above.

The hardware inside consists of a steel mounting plate attached to the front edge of the workbench. This fixed plate has a threaded "nut" that accepts the screw of the tail vise. As you turn the handle, the vise assembly slides back and forth along the mounting plate.

To keep the vise level and sliding smoothly, a pair of steel guide plates are sandwiched around the top and bottom edges of the mounting plate. You want to build the wood box so that when the plates are sandwiched around the mounting plate, the tail vise assembly is rock solid, yet will still move easily.

Planning for a Tail Vise. The downside to a tail vise is that installing one requires the most planning. The reason for this is you have to design the top of the bench around the vise. So it's especially important to have the vise on hand before you start building your workbench.

And like a face vise, you'll have to decide on the capacity you'd like. In this case, the capacity is actually the back and forth travel of the vise. And building it into the workbench doesn't affect this movement. So the capacity specified is pretty much what

versatile clamping:
Bench Dogs & Pups

So what do you do if you already have a workbench and can't add a tail vise? You can do the next best thing. And that's to use the handy hardware you see at right.

These *Veritas Wonder Pups* and round bench dogs from *Lee Valley* only require drilling a series of $\frac{3}{4}$"-dia. holes in the top of your bench. Plus, by drilling a few more holes in your workbench and the jaw of your face vise, the vise can hold workpieces much larger than the capacity of the vise.

you get. (For a way to incorporate the capability and features of a tail vise into an existing workbench, check out the box at the bottom of the opposite page.)

TWIN-SCREW VISE

One of the more unique vises you'll find on a workbench is the one you see in the photo and drawings at right and below. Instead of a single screw moving the jaw in and out, this vise uses two handles along with a pair of screws.

How it Works. Now this doesn't mean you have to turn both handles at the same time to secure a workpiece. Under the cover you see is a chain that connects the two screws (see lower right photo). Turning either handle causes both screws to turn together.

This way, the jaws stay parallel automatically and the vise won't rack no matter how much you pressure you apply to the workpiece. (A spring-loaded lock pin allows you to disengage the chain to skew the jaws for *slightly* tapered or out-of-square assemblies.)

Two Vises in One. What I really like about this vise is that you get two for the price of one.

By drilling holes in the top of the bench and the front jaw of the vise, it works like a tail vise. (You can clamp anything up to the length of your workbench, plus the nearly 12" capacity of the vise.)

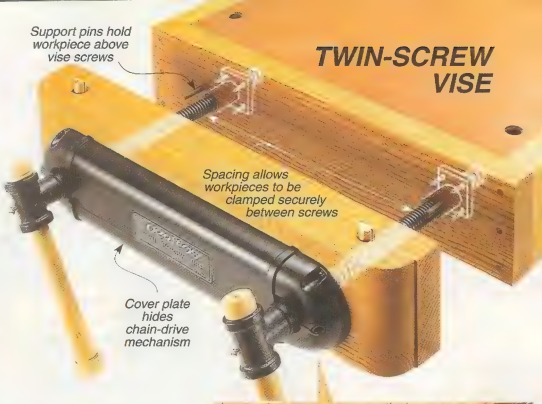
Don't need a tail vise? Simple. Just clamp a workpiece anywhere between the jaws and use it like a face vise. As an added plus, you can slip a wide workpiece vertically between the screws to work on it.

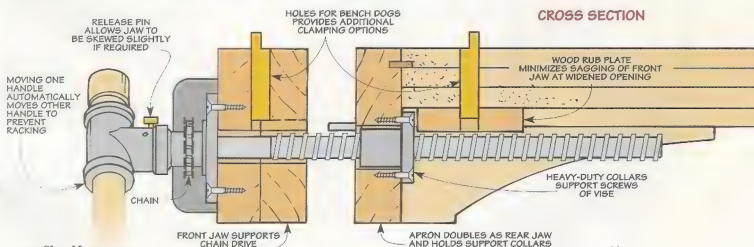
Note: You can easily install a twin-screw vise along the front edge of a workbench to make a great, large-capacity face vise.

It's All in the Kit. No matter where you install the vise, what you start with is a hardware kit made by *Veritas* that includes everything you'll need but a set of wood jaws (see page 51 for sources). The kit allows you to retrofit the vise to an existing bench or design it in from the start.

The kit comes in two "sizes" depending on how far apart you'd like to place the screws. One kit handles spacing the vise screws up to 16⅞" apart, while the other kit includes a longer chain so you can space them 24" apart.

The Choice is Yours. A face vise, a tail vise, or both — what you add or build into a workbench will provide you with more capability and improve your woodworking.





workshop Fire Safety

The last tool in your shop you'll want to use is the first tool you need to buy.

The most important tool in your shop is one most of us will never use. It's also one tool no shop should be without — a fire extinguisher.

My friends in the fire department say it takes three things to make a fire: fuel, oxygen, and heat. A quick look around my shop shows me plenty of available fuel sources — from wood and sawdust to paint and finishing materials.

You'll also find a number of heat sources. Tool sharpening and electric motors generate heat. Even mixing some glues and finishes can produce enough heat to start a fire.

Fortunately, all it takes to put out a fire is to remove one of those three elements.

FIRE EXTINGUISHERS

In the workshop, one of the most effective ways to remove one of the elements is with a fire extinguisher. Most fire extinguishers accomplish this by separating the oxygen from the fuel, smothering the fire.

What Kind? You can use water to put out a fire. But since electricity is usually present in the shop, this can be dangerous. Carbon dioxide extinguishers work well but they're fairly expensive. So the most practical choice of fire extinguisher for the shop is one that use a dry chemical.

What's Inside? Dry chemical extinguishers have a dry powder (a lot like baking soda) and an aerosol propellant inside. They work a lot like a can of spray paint. When you press the lever, the propellant forces the powder out on the fire.

These extinguishers are also the best all-around choice because they'll put out most types of fires. They can effectively put out wood and flammable-liquid fires. And since the powder won't conduct electricity, it's good for electrical fires as well. Best of all, they're inexpensive and readily available.

How Big? You can find dry chemical fire extinguishers in sizes ranging from 2 lbs. all the way up to giant, 350-lb. wheeled tank canisters. The weight designation refers to the amount of chemical that's inside the extinguisher.

When you look for extinguishers at home centers and hardware stores , you'll find the 2-lb. and 5-lb. sizes most often. It's tempting to pick up the less-expensive, smaller extinguisher, like the one shown in the photo at left. But the minimum size you should consider for the shop is a 5-lb extinguisher, like the larger one in the photo.

The reason the larger extinguisher is a better tool is because it contains more than twice the dry

chemical. This means it lasts longer than the smaller version. You can pick up a 5-lb. model for about $50.

The bigger one also has a short hose that gives you a longer reach and makes aiming easier. Another great feature of these extinguishers is that, unless it's made of plastic, they can usually be recharged at a minimal expense (around $20).

After you get the right kind, you'll want to keep it handy, so it's easy to find if you ever need it.

LOCATION

When I asked about fire extinguishers around here, almost everyone had one. But many were a bit unsure as to exactly where they kept them. Some thought it was under the bench and others thought it was sitting somewhere in the far corner of the shop.

The thing is, if your extinguisher is stored where it's hard to find or you can't get to it quickly, it won't be much help when you really need it. That's why I always try to mount mine on a quick-release bracket near an exit.

MAINTENANCE

Just like any tool, your fire extinguisher requires attention. But you'll find that a few minutes each month is all it takes to keep it in good working order.

First, because the propellant can leak out over time, check the dial every month to make sure the charge is still good. If the gauge shows the charge is low, you'll need to get the extinguisher recharged or buy a new one. I also have mine checked and tagged by a fire safety professional at least once a year (see photo at right).

Whenever you check the gauge, quickly turn the extinguisher upside down once or twice. This keeps the dry chemical that's in the canister from settling and caking inside. That way, the chemical will be completely expelled along with the aerosol if it's used.

A final thing to remember is if you ever use your extinguisher (even a little bit), be sure to have it recharged. Partially used extinguishers are more prone to leaking and may not work well (if at all) when you really need it.

IF A FIRE BREAKS OUT

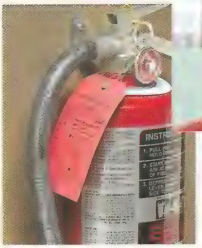
You hope you never have a fire. But if you do, there are a few things you'll want to keep in mind.

Phone First. The very first thing you need to do is call the fire department. Do this even if you're able to put the fire out. You'll want experts to make sure the fire is not smoldering somewhere, only to reignite later. Remember, the fire extinguisher only deprives oxygen to the fire. It doesn't cool down the burning materials. A visit by the fire department may also be needed if you're going to file an insurance claim.

Secondly, if you attempt to put the fire out, stay low to avoid the smoke. And keep yourself between the fire and an exit so you won't run the risk of being trapped.

Finally, know how to operate your extinguisher before you need to use it. The box below shows you an easy-to-remember technique.

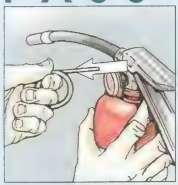
A fire extinguisher is the one tool you'll buy and hope never to use. But it could be the most important tool purchase you ever make.



▲ *Annual Inspection. A yearly inspection ensures the extinguisher is in good working condition.*

▲ *Frequent Check. A quick gauge check lets you know it's charged and ready.*

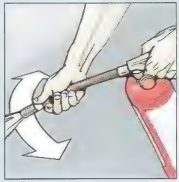
How To:
P-A-S-S



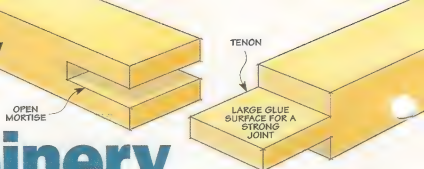
▲ *P - Pull. The first step in putting out a fire is to pull the safety pin so you'll be able to squeeze the lever.*

▲ *A - Aim. For the best effect, aim the nozzle of the extinguisher at the base of the fire, not at the top of the flames.*

▲ *S - Squeeze. Squeeze the lever handles together to allow the propellant to spray the dry chemical onto the fire.*



▲ *S - Sweep. Finally, use a side-to-side sweeping motion to spray the chemical across the burning surface.*



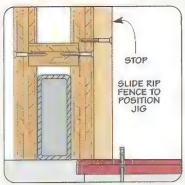
no fuss Bridle Joinery

Mortise and tenon joinery is second to none when it comes to building strong frames like those for doors and frame and panel assemblies. But if you have a lot of mortises to cut, it can be a time-consuming task.

In these situations, I usually turn to the bridle joint. This variation of the mortise and tenon shares many of its strengths, but adds a key advantage — it can be cut entirely on the table saw.

Open Mortise. Unlike a traditional mortise, the mortise in a bridle joint is open on the end, as you can see in the drawing above. This open design makes it easy to cut on the table saw. It also simplifies sizing of the parts since there's no joinery to account for.

Simple Tenoning Jig. The key to cutting a bridle joint on the table saw is using a tenoning jig like you see in the photo below.



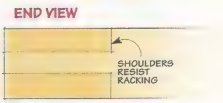
The jig is basically a saddle that rides along the rip fence. The workpieces are held vertically. This leaves smooth mortise and tenon cheeks for a solid glue joint.

Prepare the Workpieces. Before getting into how to cut the joint, I want to mention one more thing. I like to cut a few extra pieces from the same width and thickness I'm using to set up the jig. A little time spent upfront on setup will make things easier later on.

CUTTING THE MORTISE

Just like making a traditional mortise and tenon joint, I start with the mortise. For me, it's easier to fit the tenon to the open mortise.

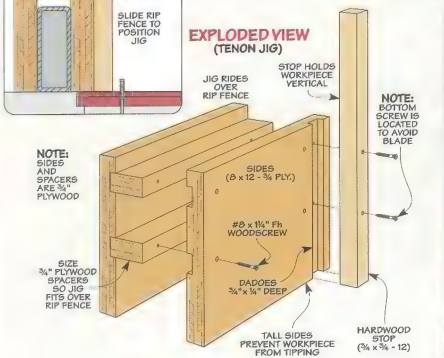
The process for cutting an open mortise is straightforward. Start by clamping a test piece in the tenoning jig. Then set the rip fence (and jig) so the blade will cut a kerf just off the centerline away from the fence, as shown in Figure 1 on the opposite page.



Test Mortise. The next thing to do is set the blade height. Here, you'll want the height of the blade to match the width of the tenon piece. To do this, I use one of the parts as a set-up gauge.

Now, you can turn on the saw and make a cut. After sliding the jig back, unclamp the workpiece, flip it around, and make a second cut. This two-pass method centers the mortise in the workpiece. (Offset mortises are cut a little differently. You can read more about this in the box on the opposite page.)

Sneak Up on Width. With the mortise started, you can check its width and readjust the fence. I like



to start by cutting a narrow mortise and work my way up to the final width. This means I can do all the setup on a single piece.

Once you're satisfied with the mortise width, you can go ahead and complete all the mortises.

A TENON TO MATCH

After cutting the mortises, you can begin work on the tenons. The process goes nearly the same as for the mortises. Only instead of cutting a groove, you'll be cutting a notch on either side of the workpiece.

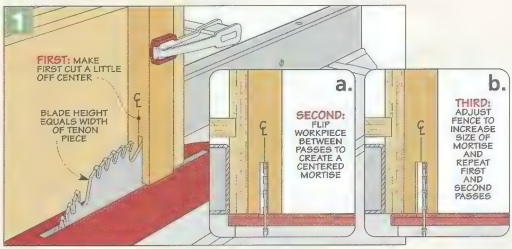
Start Wide. To get started, I set the fence so that the tenon will be a little "fat." This way, I can sneak up on the perfect size. Next, you can make a cut, flip the workpiece around, and make a matching cut on the other side, as shown in Figure 2. (If your parts are the same width, you won't need to adjust the height of the blade.)

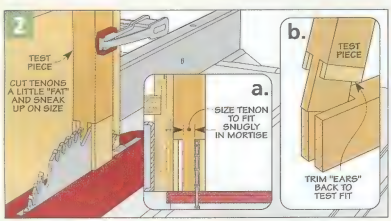
You'll notice that there are "ears" on the outside edges of the piece. To test the fit of the tenon, you'll need to cut away the ears on your test piece with a hand saw. When you're satisfied with the fit, you can go ahead and cut all the cheeks.

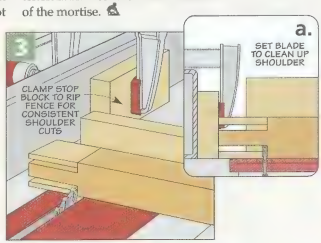
Shoulders. All that remains to complete the tenon is to cut away the ears. This step also cleans up the shoulders of the tenons.

This final cut is made with the workpiece lying flat on the saw table. I set the blade so it's high enough to trim the ear and still not cut into the tenon. The other bit of setup you'll need to do is to attach a stop block in front of the blade, as in Figure 3. This will give you consistent results and ensure the cut-off piece isn't trapped between the fence and the blade.

Clamping. There's one last thing to mention. When assembling the joint, I like to put a clamp right over it. This keeps the cheeks of the tenon in firm contact with the sides of the mortise.





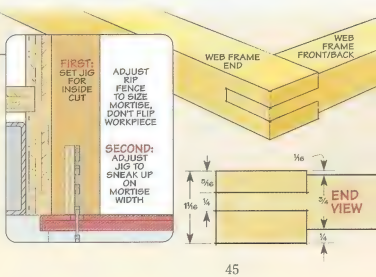


Offset Bridle Joint

Bridle joints are used to construct the web frames in the workbench on page 16. But they are cut a little differently.

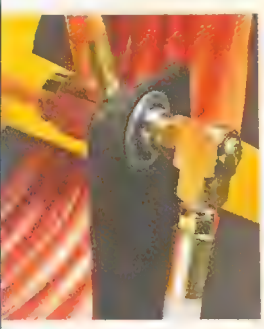
Here the parts are two different thicknesses. And instead of a centered mortise and tenon, the mortise is offset slightly to keep the drawer front from scraping against the web frame rails.

To cut the mortise, start by setting the jig so the blade will cut the inside face to the dimension shown in the detail at right. Then cut a kerf in all the web frame stiles for a consistent result. The next step is to nudge the fence over a bit until the mortise is widened to its final size (1/4"). Now, complete mortises in the rest of the parts.



selecting a Hose Reel

Keep your air hose from ending up in a heap on the shop floor.



▼ *Swivel Fitting. A brass swivel fitting at the end of the shaft that holds the reel allows it to turn without twisting the hose.*

More and more, I find myself reaching for air-powered tools while working in the shop. But as useful as air tools are, there's one aspect about them that I don't like — coiling up the hose when I'm done working. That's where an air hose reel comes in handy.

Although there are lots of hose reels on the market, they all work more or less the same. The hose is wound around a spool-like reel. A short length of hose connects the reel to your compressor. And a swivel fitting allows the reel to turn without twisting up the connector hose. The main difference between the various reels is the way they retract the hose. Some work manually, while others are automatic.

▲ *Same Concept — Different Styles. Although they may have different mounting styles and hose retraction systems, all hose reels work basically the same.*

MANUAL REELS

The most basic type of air hose reels are manual (see photos at top of opposite page). These use a simple hand crank to wind the hose back onto the reel. The main advantage of this type of reel is its low cost. You can pick one up for around $30 or $40. And because they're so simple, there aren't too many things that can go wrong with this type of reel.

A manual reel is a good choice if you use air tools only occasionally. It serves its purpose by keeping your air hose neatly coiled and stored. But having to roll up the hose by hand takes more time than the automatic reels. Plus, you have to manually guide the hose back

Hand Operated. With most manual reels you have to guide the hose as you wind it back onto the reel.

▲ *Portable.* *The handle design of this reel allows you to carry it comfortably with one hand.*

onto the reel as you rewind it to make sure it doesn't get tangled up. If you're going to be using your air hose reel every day, you'll probably want to spend the extra money to get an automatic reel.

AUTOMATIC REELS

Like the name implies, automatic reels retract the hose automatically, usually through means of a spring-loaded mechanism inside the reel. As you pull the hose out, tension is placed on a torsion spring, while a ratcheting device keeps the reel from rewinding. Then when you're done for the day, you simply give the hose a quick tug to disengage the ratchet, and the spring winds the hose back onto the reel.

Most automatic reels also feature a hose guide with rollers that prevents the hose from snagging as you're pulling it out or winding it back onto the reel. A stop attached to the end of the hose prevents it from rewinding too far.

The great thing about automatic reels is that they work quickly and smoothly. All you have to do is walk the hose back to the reel while it rewinds. The reel does all the work for you.

Safety Reels. There's one downside to automatic reels. If you accidentally let go of the end of the hose as the reel is rewinding, it can whip around wildly, possibly injuring someone or damaging something nearby.

To prevent this, some hose reels are equipped with a safety rewind system that controls the speed at which the reel rewinds the hose. These reels are a bit more expensive than others, but this safety feature is nice to have.

◀ *Automatic.* *These reels use a spring-loaded mechanism to rewind the air hose. The reel on the right also features a safety rewind system.*

Selecting a Reel. Aside from the retraction method, there are some other things to consider when shopping for an air hose reel. First, since most of these reels come with an air hose, you want to choose a hose length and diameter that fits your needs. You'll typically find hose reels with 25' or 50' hoses, but reels with longer hoses are available.

You'll also need to decide where you're going to mount the hose reel. Most reels can be adapted to mount on a wall, a ceiling, or the floor. If you do a lot of work off-site, you may want to purchase a portable hose reel like the one shown above.

Finally, you'll have to consider your budget. The lower-priced reels will get the job done, but the more expensive reels have upgraded features like beefier bearings, high-quality swivel connectors, heavier steel construction, better hoses, and powder-coated finishes to resist wear. In the end, it all comes down to weighing your needs versus the cost.

ULTIMATE Garage

roll-around Tool Cabinets

◄ *Finish.* Ball-bearing slides on this cabinet allow the drawers to slide smoothly even when fully-loaded.

▼ *Friction Slides.* Metal friction slides are long-wearing, but don't operate as smoothly.

Learn what to look for when choosing a roll-around tool cabinet.

Roll-around tool cabinets were once thought to be the domain of auto mechanics and factory workers. But today, you'll find them in more and more home shops and garages. And it makes sense. Available in many sizes and drawer configurations, they're great for storing all sorts of tools — not just wrenches and sockets.

But as soon as you start shopping for a roll-around cabinet, you'll discover that prices are all over the map. And you might wonder (as I did) if you're paying more just for a fancy name. To find out, we took a look at a couple of tool cabinets at opposite ends of the price range. One is a consumer-grade cabinet that we purchased for under $100. The other one is an industrial-quality cabinet that sells for roughly four to five times more.

Now, on the surface, this might seem like an unfair comparison. But we weren't trying to do a head-to-head comparison to see which cabinet is better. Instead, we just wanted to see what features (if any) the extra money buys you.

Steel. The first difference I noticed between the two cabinets was the thickness of the steel components. As you might expect, the more expensive cabinet uses a thicker gauge of steel. But there's more to it than just the thickness.

The consumer-grade cabinet uses the same thickness of steel on all the parts — the case top, sides, and even the drawers. But the industrial cabinet puts extra-thick sheet metal where it really counts. The bottom pan of the cabinet is thicker than the sides in order to support the weight and prevent the cabinet from racking as it's rolled around. Likewise, the drawer bottoms are thicker in order to hold plenty of tools without sagging.

You'll also notice that the case of the more expensive tool cabinet is reinforced with extra bracing and

◄ *Thicker is Better.* Heavy gauge steel means the chest at the far left will hold up better over the long haul.

◀ *Bracing. The tool cabinet on the left has extra bracing under the top and on the sides of the case. The cabinet on the right isn't reinforced quite as well.*

ribbing. And this is really important to how well the cabinet will hold up over time (left photo above). Light-duty cabinets can sag and rack, which in turn affects how well the drawers fit in the case.

Drawer Slides. Speaking of drawers, the drawer slides are another area where you'll notice a difference. In the photos above, you can see there are two basic types of drawer slide.

The consumer-grade cabinet uses metal friction slides which are less expensive to produce. They work, but they can bind and stick, especially when the drawers are heavily loaded with tools. But you won't have that problem with the industrial cabinet. That's because the drawers ride on roller-bearing slides. So they slide smoothly even when fully loaded.

Casters. If you plan on rolling your tool cabinet around the shop, one feature you'll want to pay attention to is the casters. The casters on the higher-priced cabinet feature large, rubber wheels that turn smoothly and can roll over power cords and other obstacles. The less-expensive cabinet has hard, plastic casters that are smaller and tend to get hung up on items littering the floor.

Locking Mechanism. To keep tools secure, both tool cabinets have locking drawers. The lower-priced cabinet uses a metal bar that slips into slots at the top and bottom of the cabinet to prevent the drawers from being opened. But it wouldn't take much to cut through the bar with a hack saw.

The lock on the industrial cabinet is mounted inside the case, so it's harder to overpower. And another nice feature of this particular cabinet is that you can leave one drawer open and still lock the others. Then when you (or your neighbor) returns a tool to the cabinet, simply close the open drawer and it will lock automatically.

Fit and Finish. One other thing I noticed when comparing these two cabinets is the difference in the overall fit and finish. Open one of the drawers of the consumer-grade cabinet and you'll notice that the edges of the sheet metal are sharp and unfinished. But on the higher-priced cabinet, the sheet metal edges are rolled over to provide a smoother, stronger edge.

There's also a difference in the paint jobs on the two cabinets. The industrial cabinet has a powder-coated, "wrinkle" finish that's durable, and hides fingerprints and smudges. The less expensive cabinet has a painted finish that scratches easily. These may sound like minor details, but they are the kinds of things that make the higher-priced cabinet a pleasure to use.

Value. So the question is whether or not an industrial-quality cabinet is worth the extra money. The answer really depends on how you'll use the cabinet — and your budget. Tool cabinets designed for industry standards can withstand years of heavy use. In a factory setting, a tool cabinet can be rolled around up to a mile a day.

But most homeowners may only move their tool cabinets a few feet a year — to sweep underneath them. If that's the case, a less expensive tool cabinet might just be the perfect choice; providing secure, organized storage for all your tools. And that will leave you with some extra cash in your pocket to buy the tools to put inside the cabinet.

▼ *Locking Drawers. A locking mechanism on the inside of the chest (upper photo) is more secure than an exterior lock (lower photo).*

▼ *Casters. Large, rubber casters (upper photo) allow a tool chest to roll smoothly on uneven surfaces.*

Q&A

questions from
Our Readers

vertical-grain Douglas Fir

In issue No. 80, you featured a tool cabinet made out of Douglas fir. When I tried to buy Douglas fir locally, all I could find was framing lumber and it doesn't look anything like the wood you used. Why is this?

Art Beauchamp
Baton Rouge, LA

Whenever we build projects out of Douglas fir, we typically use ordinary framing lumber (commonly known as "two-by" stock). But for the heirloom tool cabinet in Issue No. 80, as well as the workbench on page 16 of this issue, we used *vertical-grain* Douglas fir.

Vertical-grain Douglas fir isn't a different species or type of wood. Instead, this wood gets its name from the way it's cut at the sawmill. If you take a look at the end of a piece of vertical-grain fir, you'll see that the growth rings run nearly perpendicular to the face of the board, producing a straight, even grain pattern.

On the other hand, most framing lumber has grain that runs almost parallel with the face of the board, typically resulting in a loose, wavy grain pattern. (See photos in margin at left for comparison.)

Growth Rings. Just as important as the grain direction is the tree that the wood comes from. The best-looking fir comes from trees that grow up in mature, established forests. These trees grow slowly because they're competing with neighboring trees for light, air, and soil nutrients. And the slower a tree grows, the closer the annual growth rings are spaced, resulting in a tighter grain pattern.

On the other hand, trees that are commercially planted and harvested tend to mature much quicker. And as a result, they have wider-spaced growth rings.

Sources. Vertical-grain Douglas fir isn't something you're likely to find at your local home center. You'll have better luck trying a traditional lumber dealer. And you may even have to special-order the wood. But be prepared for a little sticker shock. Because of the waste involved in sawing logs into vertical-grain boards, you can expect to pay three to four times more than you would for run-of-the-mill framing lumber.

◀ *Vertical Grain. If you look at the end of this board, you can see that the grain runs vertically.*

◀ *Horizontal Grain. Most construction lumber has grain that runs horizontally or in arcs.*

Technique: Grain Matching

Matching grain between boards is a concern whenever you're gluing up a panel. But when it came to gluing up the legs for the workbench in this issue, I faced a different kind of challenge. I wanted all four faces of each leg to look similar. To do this, I selected boards with grain running *diagonally* to the face of the board. This way, the grain on the edges of the two leg halves looks the same as the grain on the faces of the boards (see photo).

Sources

CABINET BASE WORKBENCH

You'll need to find a fair amount of hardware to build the cabinet base workbench on page 16. Most of the basic items can be found at your local hardware store. But there are some items you'll probably need to order to complete the project.

The 2" x 1⅞" antique, ball-tip hinges (00E08.05) I used to hang the center doors on the cabinet came from *Lee Valley*. And *Rockler* carries the cross dowels (31823) and shelf supports (33902) you'll need. The cherry knobs (88783) and magnetic catches (26559) came from *Rockler* as well.

You'll need a pair of vises for the workbench. The *Veritas* tail vise (70G09.01) and face vise (70G08.02) were both ordered from *Lee Valley*. The vises don't come with handles. So you'll need to make them or order them from *Lee Valley* (05G12.03). The *Woodsmith Store* also has these handles and vises.

To round out your workbench, you'll need to get some bench dogs. I used bench dogs (114141) that came from *Highland Hardware*. But you'll find that *Lee Valley* also carries bench dogs (05G02.01) that work well. It's a good idea to have the bench dogs in hand before you start work on the holes. That way, you can be sure they fit properly.

AIR HOSE REELS

A good hose reel is a great help in controlling and storing your air compressor hose. You'll find many types and styles of hose reels available from a number of manufacturers. I picked up the two *Amflo* reels featured in the article on page 46 at a local *Home Depot*.

The black, portable reel came from *Rapid Reel*. You can get dealer information by contacting them. The *EZ-Coil* system with a brake was ordered from *Coxreels*. You'll find ordering information for this reel in the right margin as well.

SLOT CUTTERS

To cut the slots for the spline joinery in the article on page 8, I used a ¼" slot cutter (53210) from *Amana Tools*. They also make a *Quadraset Assembly* (53600) that includes four cutters, a bearing, shims, and an extra-long arbor. This set allows you to cut slots ranging from ⅛" to 23/32" wide. You'll find both types available from the *Woodsmith Store*.

SPOKESHAVE

The items needed for the spokeshave on page 28 are available in most hardware stores. But you'll need to order a blade and brass bar stock.

I was able to order a 12"-long piece of 5/16" x ½" brass bar stock (bof.312x.5) from *Metal Express*. Brass bar stock (8954K188) is also available from *McMaster-Carr* but the minimum length is three feet.

The low-angle spokeshave blade (SP062) I used came from *Hock Tools*. It comes complete with threaded posts and brass knurled knobs. You'll want to be sure to order the larger, 4 7/16"-long blade.

DRILL PRESS CABINET

Most home centers carry the hardware you'll need to build the drill press accessory cabinet. But you may need to order some catches for the doors. The 7/16" magnetic catches (29280) I used came from *Rockler*.

If you're going to build the lower cabinet, you'll need a way to support the door so you can use it for a worksurface. For this, I ordered lid stays from *Lee Valley*. You'll need a right-hand (00T07.22) and a left-hand (00T07.12) lid stay.

LEVELERS & TOGGLE CLAMPS

Many of the levelers featured on page 10 and the toggle clamps from page 12 can be found at the *Woodsmith Store*. Home improvement centers and woodworking stores also carry a variety of toggle clamps and levelers. You'll find the information for some other sources listed in the right margin.

MAIL ORDER SOURCES

Similar project supplies may be ordered from the following companies:

Woodsmith Store
800-835-5084
Bench Vises, Bench Dogs, Levelers, Magnetic Door Catches, Shelf Supports, Slot Cutters, Toggle Clamps, Vise Handles, Wood Knobs

Rockler
800-279-4441
www.rockler.com
Bench Vises, Cross Dowels, Magnetic Door Catches, Shelf Supports, Wood Knobs

Hock Tools
888-282-5233
www.hocktools.com
Spokeshave Blade

Metal Express
800-657-0721
www.metalexpress.net
Brass Bar Stock

Amana Tools
www.amanatool.com
Slot Cutters

McMaster-Carr
630-833-0300
www.mcmaster.com
Brass Bar Stock

Highland Hardware
800-241-6748
tools-for-woodworking.com
Bench Dogs, Bench Vises

Lee Valley
800-871-8158
www.leevalley.com
Door Hinges, Levelers, Lid Stays, Toggle Clamps, Veritas Bench Vises & Bench Dogs, Vise Handles

Rapid Reel
866-523-2363
www.rapidreel.com
Air Hose Reels

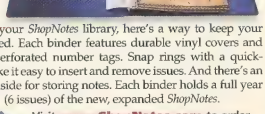
Coxreels
800-269-7335
www.coxreels.com
Air Hose Reels

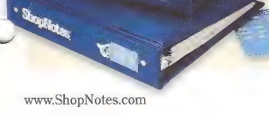
Kennedy Manufacturing
800-413-8665
www.kennedymfg.com
Tool Chests

McFeely's
800-443-7937
www.mcfeelys.com
Toggle Clamps

ShopNotes Binders

Keep your issues organized!





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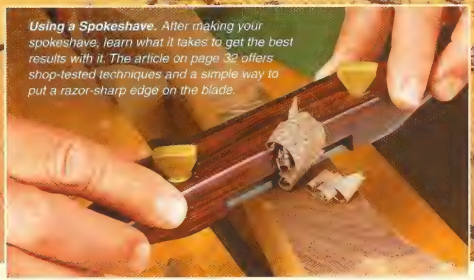
Visit **www.ShopNotes.com** to order these binders, or call **1-800-347-5105.**

***ShopNotes* Binder**

○ **701950-SN84** (*Holds 6 issues*).....$12.95

Scenes from the Shop

Wood and Brass Spokeshave. *The quickest way to get smooth, even curves is to use a spokeshave. What makes this even better is working with a spokeshave you've made yourself, like the one below. With the micro-adjustable blade, you can remove stock quickly — or take fine shavings. And, you'll find that the smoothly contoured handles give you perfect control. The article on page 28 will take you through the process.*



Using a Spokeshave. *After making your spokeshave, learn what it takes to get the best results with it. The article on page 32 offers shop-tested techniques and a simple way to put a razor-sharp edge on the blade.*

ShopNotes

Cutting Diagram
Cabinet Base Workbench

Materials

BASE FRAME

A	Legs (4)	3 x 3 - 31¾
B	Upper End Rail (2)	1¾ x 3½ - 24¾
C	Lower End Rail (2)	1¾ x 5¼ - 24¾
D	Stile (5)	1 x 3 - 23⅞
E	End Panels (4)	¾ x 10 - 23⅞
F	Lower Stretchers (2)	1¾ x 5¼ - 73½
G	Upper Rear Stretcher (1)	1¾ x 3½ - 73½
H	Back Panels (4)	¼ x 16⅛ - 23⅞
I	Support Cleats (4)	1½ x 3½ - 24¾
J	Bottom (1)	23¾ x 72½ - ¼ Ply.
K	Upper Front Stretcher (1)	1¾ x 2¾ - 73½

DRAWER CABINETS

L	Cabinet Sides (4)	24 x 23¾ - ¾ Ply.
M	Trim Stiles (4)	¾ x 1 - 23¾
N	Web Frame Ends (16)	1⅛ x 1½ - 23¾
O	Web Frame Frts./Backs (16)	¾ x 1½ - 22¼
P	Trim Rails (8)	¾ x 1 - 22
Q	Drawer Guides (4)	¾ x 1⅜ - 22¾

DRAWERS, DOORS, & SHELVES

R	Small Drawer Front (2)	¾ x 3½ - 21⅞
S	Small Drawer Backs (2)	½ x 3½ - 21⅞
T	Small Drawer Sides (4)	½ x 3½ - 23¼
U	Drawer Bottoms (8)	21⅜ x 23 - ¼ Ply.
V	Medium Drawer Fronts (2)	¾ x 4⅜ - 21⅞
W	Medium Drawer Backs (2)	½ x 4⅜ - 21⅞
X	Medium Drawer Sides (4)	½ x 4⅜ - 23¼
Y	Large Drawer Fronts (2)	¾ x 5¼ - 21⅞
Z	Large Drawer Backs (2)	½ x 5¼ - 21⅞
AA	Large Drawer Sides (4)	½ x 5¼ - 23¼
BB	X-Large Drawer Fronts (2)	¾ x 6⅛ - 21⅞
CC	X-Large Drawer Backs (2)	½ x 6⅛ - 21⅞
DD	X-Large Drawer Sides (4)	½ x 6⅛ - 23¼
EE	Guide Strips (16)	⅜ x ¾ - 23¾
FF	Drawer Stops (16)	¾ x ¾ - 2
GG	Small Shelf (1)	12 ¾ x 22 - ¾ Ply.
HH	Large Shelf (1)	22 ½ x 22 - ¾ Ply.
II	Shelf Edging(2)	¾ x ¾ - 22
JJ	Door Stiles (4)	¾ x 2½ - 23⅝
KK	Door Rails (4)	¾ x 2½ - 6⅛
LL	Door Panels (2)	¼ x 6¼ - 19⅛

BENCHTOP

MM	Benchtop (1)	1 x 27 - 92½
NN	Spline	1 x 450 (Rgh.) - ¼ Hdbd.
OO	Back Apron (1)	1¾ x 4¾ - 92½
PP	Front Apron (1)	1¾ x 4¾ - 94¼
QQ	Left End Apron (1)	1¾ x 4¾ - 32¾
RR	Right End Apron (1)	1¾ x 4¾ - 28½
SS	Support Beam (1)	1¾ x 3¾ - 92½
TT	Cross Supports (2)	1¾ x 3¾ - 26⅞
UU	Mounting Cleat (2)	1 x 5 - 21¼
VV	Filler Strip (1)	2½ x 4¾ - 77¼
WW	Assembly Spline (1)	⅝ x 1 - 77¼
XX	Bench Dog Strip (1)	1¾ x 4¾ - 79

TAIL & FACE VISES

YY	Tail Vise Top (1)	1¼ x 2½ - 20
ZZ	Tail Vise Bottom (1)	¾ x 2½ - 20
AAA	Front Filler (1)	2¾ x 2½ - 2
BBB	Back Filler (1)	2¾ x 2½ - 3
CCC	Tail Vise Strip (1)	1¾ x 4¾ - 20
DDD	Pinch Block (1)	1¾ x 4¾ - 3
EEE	Collar Support Block (1)	1¾ x 2⅝ - 16
FFF	Face Vise Block (1)	3½ x 7⅜ - 16

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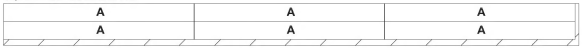
BASE FRAME

1¾" x 7" - 96" DOUGLAS FIR



1¾" x 7" - 96" DOUGLAS FIR

1¾" x 6" - 96" DOUGLAS FIR (TWO BOARDS)

1¾" x 4" - 96" DOUGLAS FIR

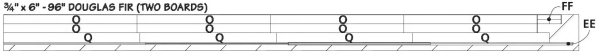
1¾" x 4" - 96" DOUGLAS FIR

1¾" x 7½" - 96" DOUGLAS FIR

DRAWER CASES

¾" x 4" - 96" DOUGLAS FIR

¾" x 6" - 96" DOUGLAS FIR (TWO BOARDS)

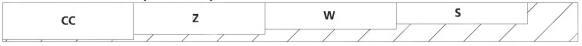


1⅛" x 4" - 96" DOUGLAS FIR (TWO BOARDS)

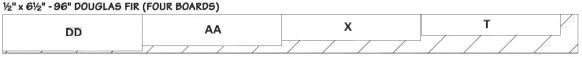
DRAWERS

¾" x 6½" - 96" DOUGLAS FIR (TWO BOARDS)

½" x 6½" - 96" DOUGLAS FIR (TWO BOARDS)



½" x 6½" - 96" DOUGLAS FIR (FOUR BOARDS)



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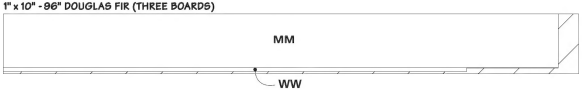
TOP

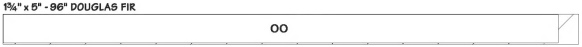
1¾" x 5" - 96" DOUGLAS FIR

1¾" x 5" - 96" DOUGLAS FIR

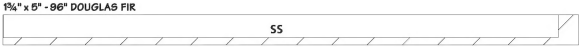
1" x 10" - 96" DOUGLAS FIR (THREE BOARDS)



1¾" x 5" - 96" DOUGLAS FIR



1¾" x 5" - 96" DOUGLAS FIR



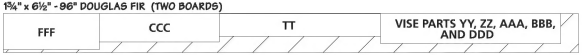
¾" x 5½" - 48" DOUGLAS FIR

1¾" x 5" - 96" DOUGLAS FIR

¾" x 5" - 96" DOUGLAS FIR

1¾" x 5" - 96" DOUGLAS FIR

1¾" x 6½" - 96" DOUGLAS FIR (TWO BOARDS)



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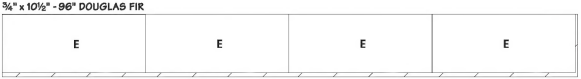
DOORS

¾" x 6" - 96" DOUGLAS FIR

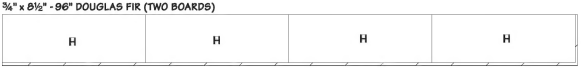
PANELS

1" x 7" - 96" DOUGLAS FIR

¾" x 10½" - 96" DOUGLAS FIR



¾" x 8½" - 96" DOUGLAS FIR (TWO BOARDS)



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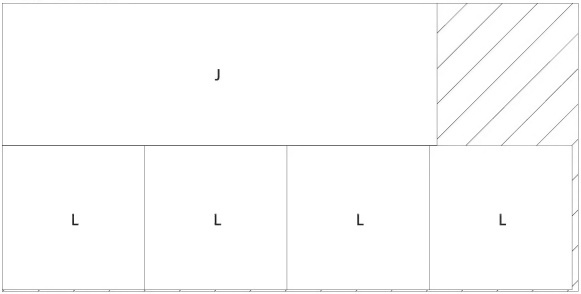
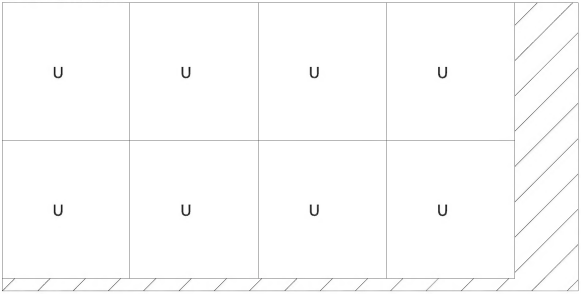
48" x 96" - ¾" PLYWOOD



48" x 96" - ¼" PLYWOOD



24" x 48" - ¾" PLYWOOD

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